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Public Health Service, Denver, Colorado

1964

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Water pollution effects (Plants)
Pesticide residues

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Program Review

PROGRAM REVIEW

Washington, D. C.
January 20-21, 1964

Colorado River Basin Water Quality Control Project

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service, Region VIII
Denver, Colorado

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1/6/64

COMMUNICATION

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I. INTRODUCTION

II. PROJECT DESCRIPTION & MAP..........

III. BACKGROUND AND OBJECTIVES..........

IV. ACTIVITIES & ACCOMPLISHMENTS, FY [illegible]..........

V. PLANS AND SCHEDULE, FY [illegible]..........

VI. BUDGET, FY [illegible]..........

VII. ORGANIZATION AND MANAGEMENT..........

VIII. OTHER [illegible] [illegible]..........

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Project Description

The long-range goals and objectives of the Project have been indicated in the prospectus Colorado River Basin Project on Water Quality Control prepared at Division Headquarters on June 3, 1960. A significant change has been made in these objectives in that the Enforcement Branch has indicated that the scope of the Project will not involve development of a comprehensive program, but will entail investigations of the critical and pressing interstate pollution problems which may now or in the future exist in the Basin.

Since the salinity of basin waters is the principal interstate pollution problem now existing in the Basin the major effort of the Project is now devoted to a study of this type of pollution, as proposed at the Fourth Session of the Interstate Enforcement Conference in May 1963 and agreed to at that time by the Conferees. A substantial reorganization of the Project's structure has been carried out to implement this program and is presented in the following material.

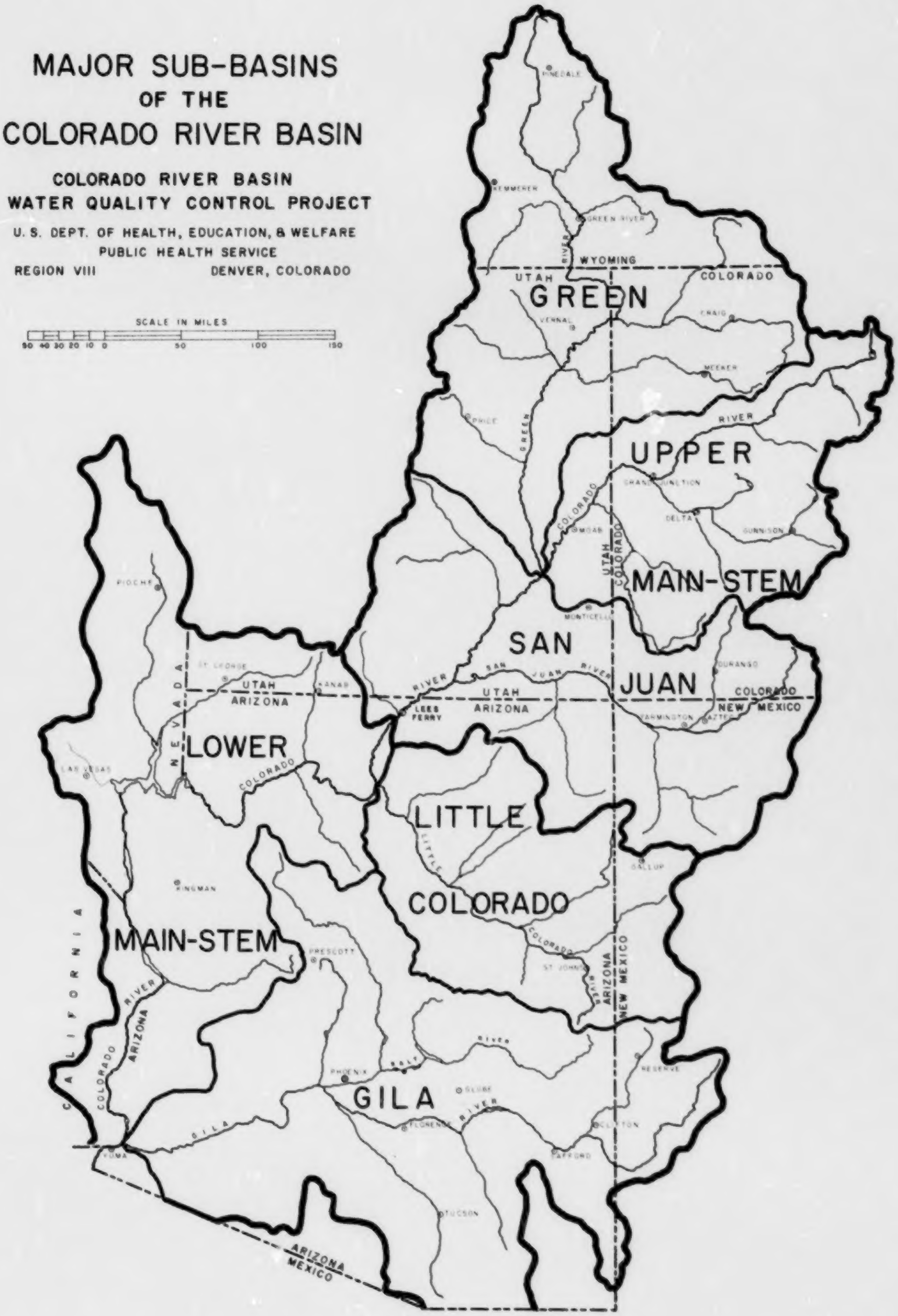
During the first half of FY 1964 considerable time has been required in connection with reorganization of the Project and recruitment, orientation and training of personnel. Visits have also been made to numerous Federal and State agencies, including universities to discuss the Project with interested parties and solicit their cooperation.

A surveillance program with respect to radiological pollution in the Basin is also being carried forward. Exploratory investigations of pesticide content of river waters in the Lower Basin have been initiated.

MAJOR SUB-BASINS OF THE COLORADO RIVER BASIN

COLORADO RIVER BASIN
WATER QUALITY CONTROL PROJECT

U. S. DEPT. OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION VIII DENVER, COLORADO


SCALE IN MILES
50 40 30 20 10 0 50 100 150
GREEN
UPPER
MAIN-STEM
SAN JUAN
LOWER
MAIN-STEM
LITTLE COLORADO
GILA
WYOMING
UTAH
COLORADO
NEVADA
ARIZONA
NEW MEXICO
CALIFORNIA
ARIZONA MEXICO
PINEDALE
KEMMERER
GREEN RIVER
VERNAL
CRAIG
MEEKER
PRICE
GRAND JUNCTION
DELTA
GUNNISON
MOAB
MONTICELLO
DURANGO
FARMINGTON
AZTEC
LEES FERRY
ST. GEORGE
KANAB
PIOCHE
LAS VEGAS
KINGMAN
PRESCOTT
GALLUP
ST. JOHNS
PHOENIX
GLOBE
FLORENCE
RESERVE
CLIFTON
SAFFORD
TUCSON
YUMA
GREEN RIVER
COLORADO RIVER
SAN JUAN RIVER
LITTLE COLORADO RIVER
SALT RIVER
GILA RIVER

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1/2/64

Cooperating Groups

Federal Agencies

1. Western Basin Programs, River Basin and Watershed Branch, Economic Research Service, U. S. Department of Agriculture, P. O. Box 290, College Station, Logan, Utah.

   This agency is providing continued assistance in the agricultural phases of an Economic Base Survey of the Colorado River Basin under a reimbursement agreement.

2. Geological Survey, Water Resources Division, U. S. Department of the Interior

   Area offices at Denver and Grand Junction, Colorado; Salt Lake City, Utah; Yuma, Arizona; Santa Fe and Albuquerque, New Mexico are continuing to provide water quality, stream gaging, and flow information. Arrangements have been made for this information to be obtained prior to official publication. The Survey also collects salinity samples at certain of the Project network sampling stations.

3. Bureau of Reclamation, U. S. Department of Interior

   Area offices in Denver and Grand Junction, Colorado; Salt Lake City and Provo, Utah; Boulder City, Nevada; Phoenix and Yuma, Arizona; and Rock Springs, Wyoming, have continued to be of assistance to the Project by providing water quality, irrigation use, and stream flow information and data. The Bureau collects samples at certain Radium Monitoring Stations. They have also coordinated their activities with those of the Project in the sediment survey of Lake Mead.

4. U. S. Fish and Wildlife Service, Bureau of Sports, Fisheries, and Wildlife, Department of Interior

   The area office in Parker, Arizona has indicated interest in development of a cooperative pesticide investigation program in the vicinity of the Colorado River Indian Reservation Irrigation District. The Yuma and Parker, Arizona offices provide water transportation on Lake Havasu and Imperial Reservoir.

5. Bureau of Indian Affairs, Department of Interior

   Area offices in Phoenix and Parker, Arizona have been cooperative in providing data concerning irrigation water uses in the Colorado River Indian Reservation Irrigation District, and have offered their assistance in the pesticide sampling program.

6. U. S. International Boundary and Water Commission

   This agency collects samples and provides flow data for the Colorado River at the northerly U. S.-Mexico boundary.

7. U. S. Atomic Energy Commission

This agency works with the Project on the solution of radiological pollution problems.

8. U. S. Salinity Laboratory, Agricultural Research Service, Department of Agriculture

This office in Riverside, California has agreed to cooperate with the Project by providing technical assistance and data of a nature necessary for the solution of salinity-oriented problems in irrigation and agriculture.

9. National Park Service, Department of Interior

The area office in Boulder City, Nevada provides water transportation and professional assistance for special field investigations in remote areas.

10. San Juan Physiological Research Project, DRH, Public Health Service, Farmington, New Mexico

This agency is maintaining four RMN sampling stations on the Animas and San Juan Rivers.

State Agencies

1. University of New Mexico

Under a contractual agreement, this group is carrying out an Economic Base Survey of the Colorado River Basin.

2. Metropolitan Water District, Southern California

This office provides water quantity and flow data on the Colorado River Aqueduct. They also operate a Project RMN sampling station.

3. San Juan Basin Health Unit, Durango, Colorado

This office is maintaining one of the Project RMN sampling stations on the Animas River.

I COMMUNICATION..

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Salinity Program

1/3/64

Introduction

The objectives and approach of the salinity study currently in progress in the Lower Basin were discussed generally at the Fourth Session of the Interstate Conference in May 1963, and are more specifically outlined in the Technical Design document appearing in Appendix A of this report. This document has been developed to specify program approaches, elements, and objectives sufficiently broad for implementation in each of the six sub-basins into which the Colorado Basin has been divided for study purposes. Specific application of this outline to the Lower Main Stem Sub-Basin is discussed in this portion of the report.

It will be noted that the program involves the determination of present salinity conditions in basin waters, projections of probable future conditions, estimation of the type and degree of economic damages to water uses associated with various salinity concentrations, investigation of the technical feasibility and effects of certain methods of controlling salt discharges to the river, and a balance of damages vs. control costs to show salinity concentrations which will permit the optimum net benefit to the Basin's economy.

During this study, the Project will consider only the technical aspects of the situation in the Basin, and what improvements might be possible without considering what changes in State water laws might be required to actualize the recommendations and conclusions of the study. Water rights will be recognized to the extent that they impose a present constraint on use of water by the several users.

Activity: Phoenix Field Station (established August 1963)

The tasks of the Field Station are to collect and analyze data on existing water quality and streamflows, and to prepare interpretative reports identifying and characterizing sources of saline pollution in the Colorado River Basin. In carrying out this function it has established, and is now operating a water quality sampling network in the lower Colorado River sub-basin. The staff will also develop the analytical field data required in the office studies of the Salinity Damage Assessment and Salinity Control sections at Headquarters.

August and September of 1963 were devoted to recruitment and training of staff, acquisition of supplies and equipment, and establishment of offices in Phoenix. It was necessary to make preliminary reconnaissance surveys to locate stations in the field sampling network. Other tasks incidental to organization of the Field Station were preparation of a detailed work plan and a budget of operations for the present fiscal year.

Visits were made to field offices of interested Federal, State and lesser governmental agencies in the lower basin to inform them of the nature and purpose of our work, to solicit their cooperation, obtain antecedent data useful to us, and to concert efforts in water quality studies. Among the agencies contacted were the Bureau of Reclamation, the Geological Survey, the International Boundary and Water Commission, the U. S. Salinity Laboratory of the Department of Agriculture, the Colorado River Board of the State of California, the State Water Pollution Control Board, the Colorado River Indian Agency and the Palo Verde (California) Irrigation District.

The sampling network presently in use comprises 25 stations from Hoover Dam to the southerly international boundary with Mexico. Four of these stations, however, are concerned only with organic pesticides. Of the 21 salinity sampling points, 14 are operated by the Field Station and the remaining seven by other agencies of the U.S. Government and the Metropolitan Water District of Southern California. Grab or random samples are collected weekly or bi-weekly, according to accessibility of the stations, and are analyzed routinely for chemical composition of dissolved minerals, and for certain physical properties, such as pH and specific electrical conductance. At longer intervals special tests will be made for iron, manganese, phosphates and toxic metals. A detailed description of sampling rationale and procedure entitled "Phoenix Field Station Program, Lower Main-Stem Sub-Basin, Fiscal Years 1964-1965", is given in appendix B (under Other Material).

As well as the lower main-stem sub-basin, additional water sampling networks will be established on streams of the adjoining Gila and Little Colorado River sub-basins, beginning about May 1964. Office studies have begun already for location and operation of these networks.

Beside surveys of quality of water in natural streams, the Field Station will conduct saline waste water surveys of salt pollution from ground-water sources (springs and diffuse ground water seepage), from municipal and industrial sources, and from irrigation return flows in the sub-basin of the lower Colorado River main-stem. Municipal and industrial waste water surveys are planned in the four largest urban centers of the area, Las Vegas, Yuma, Needles, California and St. George, Utah, and will begin in March or April 1964.

During fiscal year 1964, the Field Station will endeavor to develop ancillary data required by Project Headquarters for assessment of salinity damages including such information as industrial water uses, classified by type; industrial water treatment and conditioning practices; and consumptive use of water by various crops in irrigated agriculture. Studies will also be made of salinity concentration influences, i.e., natural phenomena tending to concentrate salts in streams, such as atmospheric evaporation, consumption by non-beneficial vegetation, and precipitation of the less soluble salts in reservoirs.

It is expected that before the end of fiscal year 1964, the Field Station will accomplish about 65 percent of its total required work in the lower Colorado River main-stem sub-basin, and about 15 percent of the work necessary in the adjoining Gila and Little Colorado River sub-basins.

Activity: Salinity Damage Assessment (Established July 1963)

The function of the Salinity Damage Assessment section is to appraise physical and economic effects of salinity on the major beneficial uses of water -- municipal and industrial supply and agriculture. Effects on recreational uses of water and fish and wildlife propagation will also be considered; the Salinity Damage Assessment section will be assisted in the latter work by the Senior Project Biologist. Appreciation of salinity damage is prerequisite to control or abatement measures. It is evident that from a purely economic view, expenditures for salinity abatement should not exceed anticipated benefits. The penalty costs of salinity and hardness in municipal, industrial and agricultural water supply, and in recreational water uses are therefore to be estimated in order to provide a basis for evaluating benefits of proposed salinity control measures.

During the 1964 Fiscal Year, the Salinity Damage Assessment section is assembling and studying relevant data on present water supply and water quality in the Colorado River Basin, with particular emphasis on one sub-basin of that river system, the Lower Main-Stem of the Colorado River from Lee Ferry southward to the Mexican border. The section is also procuring and studying available projections of water supply, demand and quality at future dates up to the year 2020. These data will provide the basic terms or elements necessary to calculation of economic damages.

A further step in the appraisal of economic effects of salinity and hardness is the derivation of unit benefits and costs of variations in water quality, with especial reference to dissolved mineral solids and hardness. Wherever possible, the section is attempting to determine specific penalty costs, that is, the cost per unit rise in hardness or total dissolved mineral solids for the various beneficial uses of water.

Damages are being assessed relative to selected levels of water quality. The latter may represent conditions prevailing at present, or some other level of quality chosen arbitrarily, but in conformity with a widely accepted standard, for example the 500 ppm limit upon dissolved solids in municipal water supplies recommended in the Drinking Water Standards of the Public Health Service.

Literature reviews are providing data on incremental costs of raised hardness in municipal and industrial supply. It is expected that estimates of loss derived theoretically in this way will be field tested by interviews with municipal and industrial water supply authorities in the local areas of water use. These incremental costs will represent such items as the higher consumption of soap and detergents, the greater expense of water softening and of conditioning and treatment of cooling water and boiler feed water. The economic damages caused by hard water are seen as a function of the total water use, actual or projected; the rise in hardness above the selected quality level; and the appropriate unit penalty cost, e.g., cost of water softening per million gallons per part per million of hardness, or expense of soap annually per capita.

The cost of more heavily mineralized water supplies in irrigation will be appraised in terms of the greater quantities required for equivalent service. This is usually the largest loss attributable to degraded water quality in irrigation. Other tangible effects will be evaluated wherever possible, including diminished production of crops, forced substitution of crops of lower value per acre, additional costs for land drainage, and increased loss of applied fertilizers through leaching.

Assistance of specialists of the U. S. Salinity Laboratory, Department of Agriculture, will be requested in evaluating agricultural damages caused by waters of poor quality. It is expected that projections of future water quality will be supplied from sources outside the Service, including the Bureau of Reclamation.

A work program, or control schedule, for salinity damage assessment in the sub-basin of the lower Colorado River main-stem follows. It is estimated that approximately 62 man-months, including secretarial time will be needed to complete assessment of salinity damages in that area. All necessary field studies for damage assessment in that sub-basin should be done during 1964 fiscal year. The target date for completion of the report is September 1964 (conditioned on receipt of economic projections).

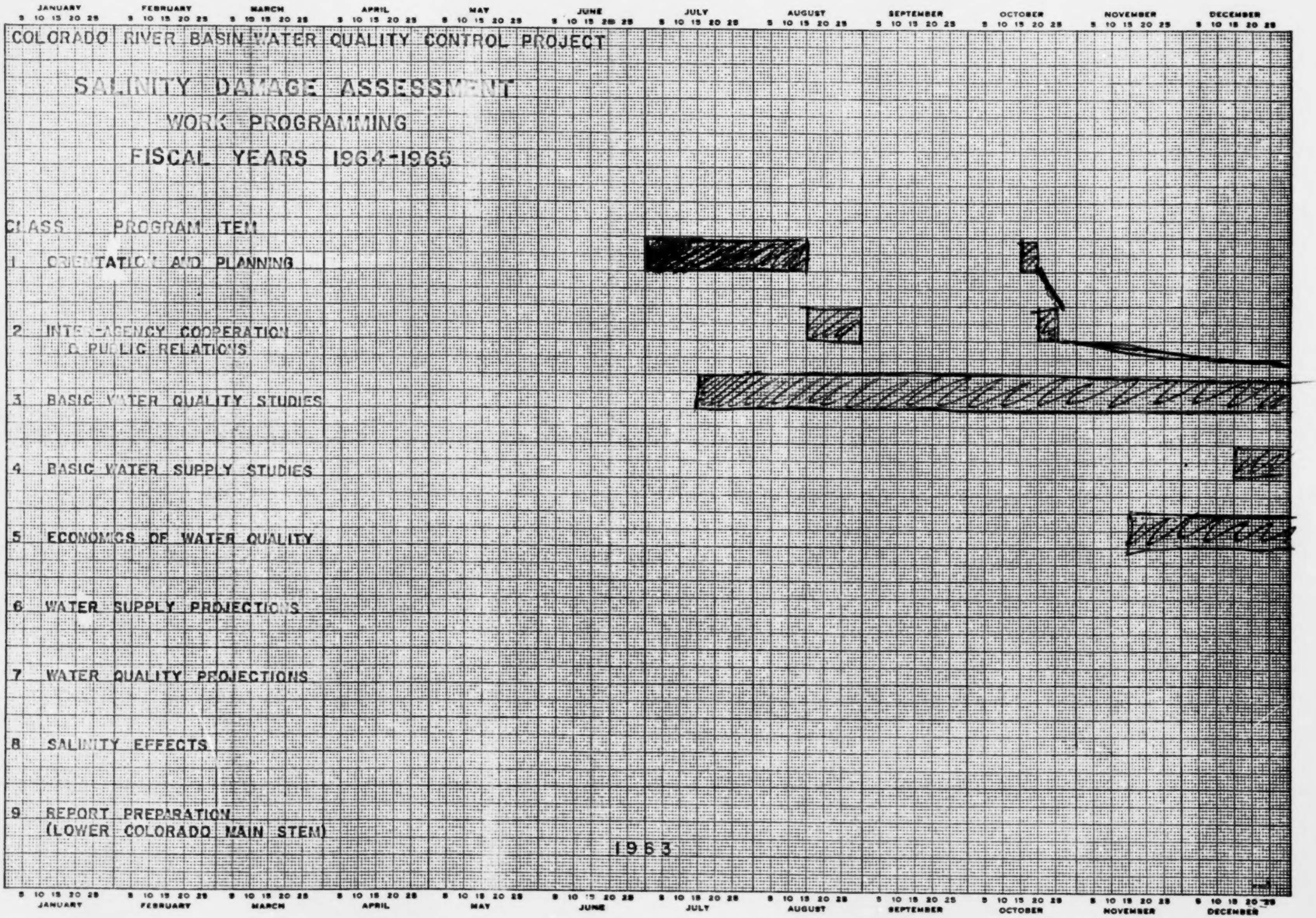
In addition to the work described above, the Salinity Damage Assessment section has devoted considerable time, during the first half of fiscal year 1964, in assisting the Phoenix Field Station in problems of initial organization, planning and program development.

Biological Program

Development of a program oriented towards defining the effects of salinity on aquatic life in the lower Basin was undertaken. The initial phases of the program will be directed towards defining present conditions in this area and assessing existing damage to or effect on aquatic life. Contacts have been made with State Fish and Game Departments, U. S. Fish and Wildlife Service and available information concerning the fishery in the Lower Main Stem has been obtained and discussed in a staff paper, "The Fishery in the Lower Colorado River". Available information concerning the Gila and Little Colorado Rivers is being obtained from appropriate agencies. Field reconnaissance surveys in these latter two sub-basins are being initiated this month. Follow up field investigations will be undertaken as indicated by the results of these reconnaissance surveys.

It is expected that this work will be completed and a reasonable assessment of any current damage obtained by the end of the fiscal year.

An approach will be developed for evaluating the effects of future expected salinity increases on aquatic life.



COLORADO RIVER BASIN WATER QUALITY CONTROL PROJECT

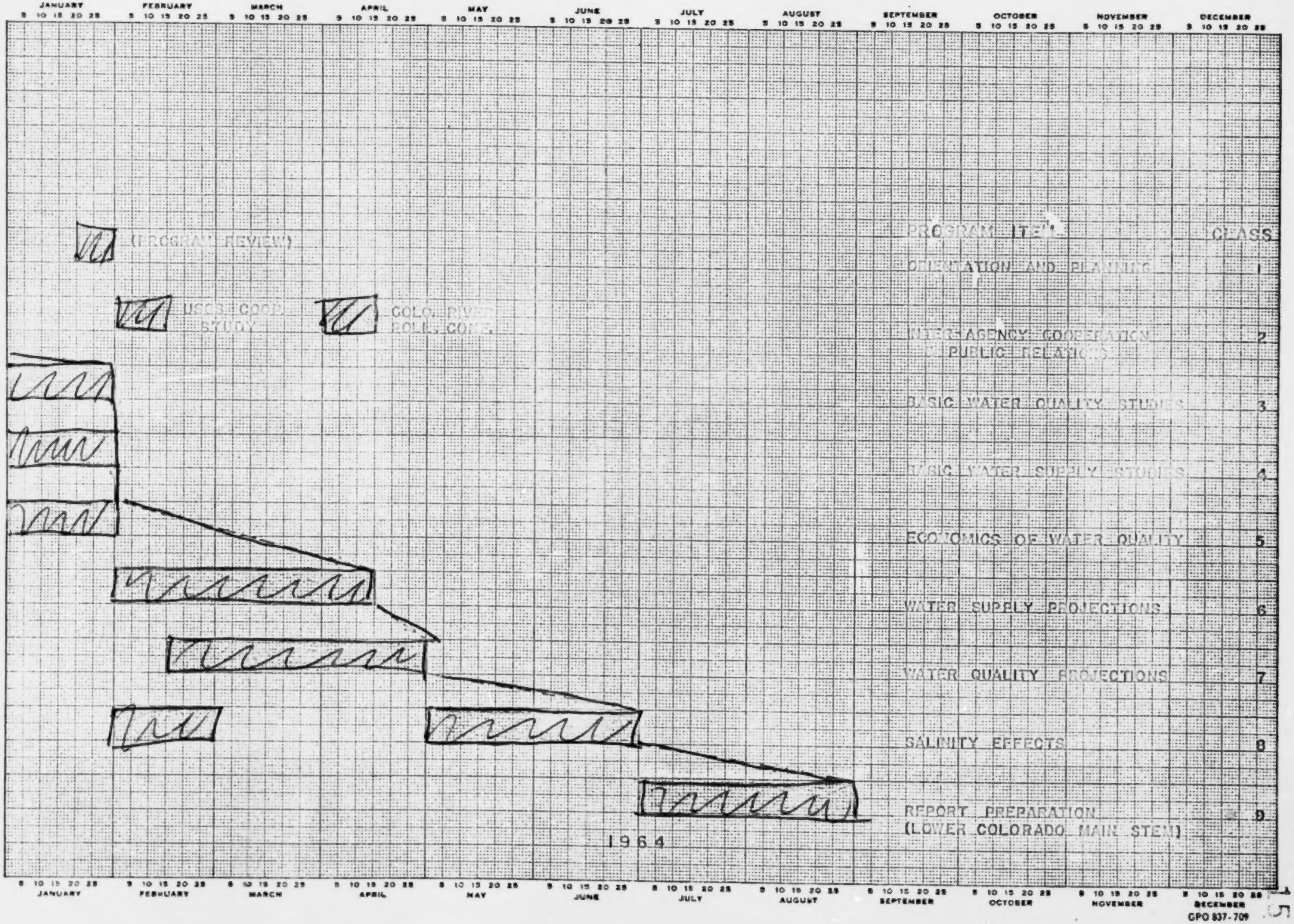
SALINITY DAMAGE ASSESSMENT

WORK PROGRAMMING

FISCAL YEARS 1964-1965

CLASS	PROGRAM ITEM
1	ORIENTATION AND PLANNING
2	INTER-AGENCY COOPERATION & PUBLIC RELATIONS
3	BASIC WATER QUALITY STUDIES
4	BASIC WATER SUPPLY STUDIES
5	ECONOMICS OF WATER QUALITY
6	WATER SUPPLY PROJECTIONS
7	WATER QUALITY PROJECTIONS
8	SALINITY EFFECTS
9	REPORT PREPARATION (LOWER COLORADO MAIN STEM)

JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
5 10 15 20 25
1963


JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
5 10 15 20 25
(PROGRAM REVIEW)
USGS GOOD STUDY
COLO. RIVER POLL. CONF.
PROGRAM ITEM
CLASS
ORIENTATION AND PLANNING
1
INTER-AGENCY COOPERATION & PUBLIC RELATIONS
2
BASIC WATER QUALITY STUDIES
3
BASIC WATER SUPPLY STUDIES
4
ECONOMICS OF WATER QUALITY
5
WATER SUPPLY PROJECTIONS
6
WATER QUALITY PROJECTIONS
7
SALINITY EFFECTS
8
REPORT PREPARATION (LOWER COLORADO MAIN STEM)
9
1964
GPO 837-709

Activity: Salinity Control (established July 1963) 1/8/64

The section to date has reviewed background information on evaporation control, canal linings, and sealants, phreatophyte control, alternative uses, diversion to waste and water reclamation.

As salinity damage assessment proceeds and information is developed by the Field Station, determination of significant sources to be considered for salinity control studies will be made. Applicable control methods for the type of source will be investigated, possible improvements in water quality determined, and costs of control measures estimated. This work will commence in the lower main-stem sub-basin during this fiscal year.

In the absence of key staff personnel for this activity, it has not been possible to firm up specific scheduling for this phase of the Project.

Contacts have been made with the U. S. Geological Survey and the U. S. Bureau of Reclamation concerning the availability of data of ground water and its effect on the salinity of the lower main-stem sub-basin.

The location and research of historical background data of major spring areas in the lower Colorado River Basin has been undertaken. Field investigations of the major spring areas, determination of their significance on salinity conditions of the lower main-stem, and preliminary evaluation of feasibility of control should be completed by April 1964.

Activity: Economic Contracts

The economic study is being conducted by the University of New Mexico in cooperation with the University of Colorado and a consultant on the demography at San Diego State College. In addition, PHS has negotiated separately with the U. S. Department of Agriculture for their participation in supplying all components of the study relating to agriculture and forestry.

During the first half of the current fiscal year, field studies were conducted to establish the coefficients of the inter-industry tables. Magnitudes of production have been established by major industry sector and final demand sectors. These magnitudes serve as control totals for the 1960 inter-industry tables, as well as provide the components of the gross regional product. They also serve as the basis upon which projections for 1980 and 2010 rest. Tentative projections of major water using and polluting industries by county, and population projections by county showing urban and rural components, have also been provided. In addition to these activities which relate to the three lower sub-basins, corrections have been made in the input-output table for the Green Sub-Basin and the gross regional product for the Green has been computed. The projections of the Green, as shown in the 1980 and 2010 input-output tables are in the final stages of completion. A simple mathematical model of the economic aspects of the Project has also been devised.

During the remainder of the fiscal year, all projections, construction of the inter-industry tables for the three lower sub-basins, and the population projections will be finished. At present, population projected according to medium and high growth paths is completed, lacking only the low projections.

Labor force will be projected from population and reconciliation of labor force projections with the labor force requirements of the projected final demands and the implied requirements shown by the inter-industry tables will be done.

If time and manpower permit, a determination of whether or not implied capital requirements are within the limits of reasonable expectation shall be made.

After the Project has ascertained cost of water for the basic economic patterns, the patterns will be modified in accordance with quality constraints in order to ascertain which patterns of water use will yield maximum gross product net of water cost, understanding that the level of output in any single industry can not exceed the level as it is projected with the water quality as a constraint.

1/6/64

Radiological Surveillance Section

Program Element: Radium Monitoring Network

Purpose: Routine surveillance of Basin surface waters for dissolved radium-226 and, more recently, for other radioisotopes of concern. This network provides a continuing determination of the degree of radiological pollution of Basin waters due to the uranium mining and milling operations in the Basin. Since FY 1963, it has provided an estimate of the degree of pollution from fallout from worldwide nuclear weapons tests.

Activities: The Radium Monitoring Network is continuing in operation with 26 sampling stations, 22 stations being located in the Upper Basin and 4 in the Lower Basin. Collection and analysis of samples for uranium for a one-year period have been essentially completed.

Routine RMN samples from eight stations are being analyzed for gross alpha, lead-210, and thorium and from seven stations for gross beta, gamma scan, and strontium-90. In addition, samples collected from five stations were analyzed for chemical as well as radiological content.

Two data releases on RMN results have been issued, and a third is planned for the latter part of FY 1964.

Current data will be examined with a view toward modification of the location and number of network stations.

Program Element: Monticello Surveys

Purpose: To evaluate the pollutional effects of residual contamination from the Atomic Energy Commission uranium mill at Monticello, Utah. This mill has been closed since 1959, but there has been considerable residual contamination of Montezuma Creek. The AEC has carried out a site improvement program in recent years, and these studies are designed to follow its effect on residual contamination.

Activities: One visit was made to the Monticello mill area in late August in conjunction with a Tailings Pile Survey at all closed-down uranium mills in the Basin. Photographs of the area were obtained, but no samples were collected. A survey is being conducted during the latter part of January to collect more water and sediment samples for radiochemical analyses.

The data obtained from six Monticello surveys will be analyzed to evaluate existing stream quality and effect of mill-site improvements.

1/6/64

Program Element: Delores-San Miguel River Sediment Surveys

Purpose: To evaluate the extent of thorium contamination of river sediments resulting from discharge of milling wastes from the Union Carbide Nuclear Company uranium mill at Uravan, Colorado.

Activities: Sediment sampling was carried out on the San Miguel River from above Naturita to its confluence with the Delores River below Uravan, and on the Delores River from just above the mouth of the San Miguel River to Gateway, Colorado.

This sample collection was accomplished before the Uravan mill's new seepage pond went into operation in August 1963.

Follow up sediment sampling is planned for January 1964 to evaluate the effect of the new seepage pond on thorium contamination reaching the river.

1/6/64

Program Element: Basinwide Sediment Surveys

Purpose: The purposes of the Basinwide sediment surveys have been mainly (1) to determine the distribution of radioactivity in bottom sediments throughout the Basin, (2) to determine the natural background concentration of radium-226 and other radioisotopes in the Basin sediments, and (3) to assess the effects of uranium mill waste discharges upon the radioactivity of Basin sediments.

Activities: A fifth Basinwide survey was carried out during August 1963. The four previous surveys were conducted in August 1960, March 1961, August 1961, and September-October 1962.

A report on the data gathered during the first three surveys was released in October 1963.

A sixth Basinwide survey is planned for March 1964, before the spring runoff flushes the stream beds. This survey will cover approximately 35 sampling points throughout the Basin.

Program Element: Lake Mead Sediment Study

Purpose: Obtain follow-up data for sediment studies conducted in past years, and attempt to obtain a radiological profile of sediment deposits in Lake Mead.

Activities: Through cooperation with the U. S. Bureau of Reclamation, a number of profile core samples have been obtained from a drill hole in Pierce Basin of Lake Mead. These samples have been sent to the Project Laboratory for analysis.

The Bureau of Reclamation will continue providing samples of bottom sediments from Lake Mead as they become available. Laboratory analysis of these samples will begin in late FY 1964.

1/6/64

Program Element: Uranium Mill Tailings Ultimate Disposal

Purpose: To gather information on the isotopic content and concentration of radionuclides in uranium mill tailings piles in order to estimate actual and potential radiological hazards in connection with the ultimate disposal of these piles. This is a joint study with the Atomic Energy Commission to develop ultimate disposal proposals.

Activities: Sample collection, stadia surveys, volume estimates, and sample analyses have been completed on the tailings piles of the eight non-operating uranium mills in the Basin.

Data correlation and report compilation has been initiated, along with a search for information as to feasible methods of tailings confinement.

A report covering the data gathered will be prepared, and the results compared and discussed in a joint PHS-AEC meeting during the Spring of 1964.

Such additional work as proves possible will be conducted on the subject of feasible methods of confining tailings by treatment of the tailings pile.

1/6/64

Program Element: Uranium Mill Effluent Study

Purpose: Determine the extent of radiological pollution of Basin waters by radionuclides, other than radium and uranium, that are contributed by uranium mill wastes reaching the streams.

In view of the recent changes in the Part 20 Regulations of AEC, which increase the allowable releases of radium-226, it will be necessary to analyze mill effluent releases on the basis of the mixture of isotopes present, rather than on the single isotope (Ra^{226}) basis which had proved adequate until now.

Activities: Samples of uranium mill effluents from all operating uranium mills in the Basin were collected and analyzed for a number of radionuclides, including thorium and lead-210.

The results are presently under study to determine the extent of sampling and analysis desired for the next survey, scheduled for the latter part of January 1964.

1/6/64

Program Element: Crop Surveys

Purpose: Evaluation of radiological content of vegetables and crops grown on farms irrigated by water containing uranium mill wastes and comparison with crops and vegetables irrigated by uncontaminated waters.

Activities: Data from all crop sample collection surveys have been compared, and a draft report prepared on the findings. Completion of the report on crop surveys should occur by FY 1965.

1/6/64

Program Element: Farm-Fertilizer Study

Purpose: Data from the earlier crop Ra^{226} surveys have suggested that phosphate fertilizers may be a significant contributing source of relatively high Ra^{226} levels in certain crops, and that some of the Ra^{226} concentrations found may not have resulted only from the use of contaminated irrigation water.

The purpose of these studies, therefore, is to evaluate the phosphate fertilizers as a source of Ra^{226} in crops in the Basin, especially feed crops, and the resulting Ra^{226} concentrations in topsoil and human foods, particularly milk.

It should be noted here that this particular activity has important implications beyond the interests of the Colorado Project, and as a result these will be joint studies with the Physical and Engineering Sciences Unit of SEC, with a significant part of the work to be conducted by that Unit.

Activities: Preliminary information concerning phosphate fertilizer sources, producers, and retail distributors has been collected. Selection of study farms and collection of initial background samples is scheduled for the remainder of FY 1964.

Pesticide Investigation

1/9/64

Purpose: This activity is intended to develop exploratory information on existing concentrations and loadings of selected pesticides in the Lower Main Stem, from Parker Dam to the Mexican Border. These findings are to be examined with respect to present gross usage of the materials in this area, persistence from past use, and importation from upstream areas. Insofar as possible, the significance of the findings, with respect to municiapl water use and effects on aquatic life will be assessed.

Activities: Sampling was commenced in the third week of October, on eight Lower Main Stem stations, six irrigation drains, at the mouth of the Gila River (which is essentially an additional irrigation drain), and on the raw and finished water supply at Yuma, Arizona. This activity will continue through October 1964.

Initial effort was made toward obtaining information on application quantities of the five pesticides under study. These are Lindane, Aldrin, Dieldrin, DDT and DDD. Attempts have been made to estimate the total pesticide usage in the study area. Contacts with Federal and State agencies and distributors and applications in Arizona have indicated that, under present conditions, about three man-months would be required to develop this information. A request was therefore made to the Arizona State Board of Pest Control Applicators to include additional information on the form used for reporting applications. This report is submitted by all applicators for each pesticide application within the State. The additional information would provide a means of deriving total quantities applied and would eliminate the need for personal canvassing of distributors and applicators. A similar contact is to be made with the appropriate agencies in the State of California.

Much time and effort was expended in field reconnaissance for appropriate sampling locations, on development of the highly specialized sampling techniques involved, on a workable sampling device, and on contacting of prospective contract samplers.

It is planned to include a limited number of herbicide analyses in this program, and to develop information concerning other pesticides in use within the study area. These additional pesticides include Parathion, Malathion, Dialox and Diabrohm.

A short-term study is currently being planned, by the Project Biologist and Field Station personnel, to assess the effects of pesticides on aquatic life in the study area. This study should be completed during FY 1964. A study is underway by a U. S. Fish and Wildlife Service biologist to explore the effects of pesticides in the Main Stem on channel catfish. The Project's program has been discussed with him and arrangements made for exchange of information and continued mutual cooperation.

The assistance of appropriate individuals within Public Health Service will be requested in the assessment of the significance of concentrations found on domestic consumption.

1-3-64

LIST OF PROJECT REPORTS AND OTHER PUBLICATIONS

Completed Reports

Number	Title	Date of Publication
PR-1	A Study of Colorado River Water Quality near Yuma, Arizona	June 1961
PR-2	Stream Surveys in Vicinity of Uranium Mills - I. Area of Grand Junction, Colorado - August 1960	Sept. 1961
PR-3	Stream Surveys in Vicinity of Uranium Mills - II. Area of Moab, Utah - August 1960	Sept. 1961
PR-4	Stream Surveys in Vicinity of Uranium Mills - III. Area of Uravan, Slick Rock, and Gateway, Colorado - August 1960	Sept. 1961
PR-5	A Preliminary Investigation of Radioactivity in Crops and Soils of Selected Areas	Oct. 1961
PR-6	Stream Surveys in Vicinity of Uranium Mills - IV. Area of Shiprock, New Mexico - November 1960	Feb. 1963
PR-7	Shiprock, New Mexico, Uranium Mill Accident of August 22, 1960	June 1963
PR-8	Preliminary Investigation of Selected Water Quality Conditions in Lower Colorado River-Parker Dam to Morelos Dam	Oct. 1963
PR-9	Studies on the Effect of Forest Insect Control with Ethylene Dibromide on Water Quality	Nov. 1963
PR-10	Radiological Content of Colorado River Basin Bottom Sediments	Oct. 1963
PR-13	Physical and Chemical Stratification in Two High Altitude Reservoirs of the Colorado River Basin	Dec. 1963

Number	Title	Date of Publication
BD-1	State and County Area Tabulations for the Colorado River Basin	Jan. 1962
BD-2	1960 Directory of Manufacturers for the Colorado River Basin	Jan. 1962
BD-3	River Mileage Tabulations for the Colorado River Basin - Communities and Major Tributaries	Feb. 1962
BD-4	1960 Directory of Mining for the Colorado River Basin	May 1962
BD-5	Land Ownership in the Colorado River Basin	Jan. 1963
None	Discussion of an Economic Base Study for the Colorado River Basin Water Quality Control Project	May 1961
ER-1	A Preliminary Economic Base Study of the Animas-LaPlata Pilot Project Watersheds in the Four Corners Area of the Colorado River Basin	July 1962
ER-2	The Purpose and Plan of an Economic Base Survey of the Colorado River Basin	Jan. 1963
DR-1	Radium Monitoring Network - Data Release No. 1	Oct. 1962
DR-2	Radium Monitoring Network - Data Release No. 2	Jan. 1963
DR-3	Radium Monitoring Network - Data Release No. 3	July 1963

Reports in Preparation

Tentative Title	Stage of Preparation	Expected date of Publication
Annotated Bibliography on the Effects of Irrigation Practices on Stream Water Quality with Emphasis on Salinity and Pesticides	Final Review	January 1964
Radium Monitoring Network - Data Release No. 4	Final Draft	January 1964
Colorado River Salinity Problem Study - Yuma, Arizona Area	First Review	March 1964
Protection of Domestic Water Supplies and Studies of Pollutional Parameters During the Green River Rehabilitation Project	First Review	March 1964
Ground Water Conditions in Vicinity of Uranium Mills of Colorado River Basin	First Draft	April 1964
A Study of Water Quality Conditions in the Animas-San Juan-La Plata Area, Summer 1961	First Review	April 1964
Radioactivity of Crops and Soils on Selected Farms in the Colorado River Basin	Final Draft	March 1964
Dolores-San Miguel Area Survey	First Draft	June 1964
Gunnison-Grand Valley Area Study	Final Draft	March 1964

Accomplishments thru June 30, 1964

The Project was reorganized effective July 1, 1963 to include the Phoenix Field Station, the Salinity Damage Assessment, Salinity Control, and Radiological Surveillance Sections, and the Project Laboratory.

The Phoenix Field Station was established in August. Initially, reconnaissance surveys were made and cooperation of other Government agencies was solicited. There followed the establishment and operation of a water quality sampling network to obtain data on water quality in natural streams and ground water salinity sources. It is expected that during the year, the Field Station will accomplish 65 percent of the work necessary in the Colorado River lower main-stem sub-basin, and 15 percent in the adjoining Gila and Little Colorado Sub-Basins.

The Salinity Damage Assessment Section, established in July, is assemblying relevant data on current water supply and quality conditions, predicting future supply and quality conditions, and appraising the economic effect of salinity and hardness on water quality. Emphasis is on the Colorado River lower main-stem sub-basin. The necessary field studies for appraising salinity damage in this sub-basin should be completed in FY 1964 and a report on the study completed by September 1964.

The Salinity Control Section is accumulating data on applicable control methods and associated costs. Information is being collected on the location of saline springs, particularly in the lower main-stem sub-basin. An evaluation of control measures for these sources of salinity should be completed by the end of FY 1964.

The Radiological Surveillance Section has maintained the RMN with 26 sampling stations. Two data releases on RMN results have been issued, and a third is planned for the latter part of FY 1964. The section has participated in a joint study with the Atomic Energy Commission on the problem of ultimate disposal of uranium mill tailings and a report on this study will be prepared in the spring of 1964. Work on evaluation of radiological content of crops in irrigated areas has continued and a report should be prepared before FY 1965. The section has cooperated with other agencies in lake sediment surveys and in conducting follow up surveys for earlier studies.

Pesticide sampling commenced in October at several lower main-stem stations and irrigation drains. The sampling will continue through October 1964. A short term study is being planned by the Project biologist and Field Station personnel to assess effects of pesticides on aquatic life in the study area. The study should be completed by the end of FY 1964.

During the year the activities of the economic contractors are concerned with the three lower sub-basins and the Green Sub-Basin. Their accomplishments are discussed in more detail in the Economic Contract section of this report.

Departure from 1964 Plans

Several factors have caused a general delay in overall Project progress. These are enumerated below:

Field Station

Staffing problems have placed the field activities approximately 3 months behind schedule. The position of Chief is still pending classification by Washington. Two candidates have been recruited for the position. One has taken another assignment. The position was finally classified January 7, 1964 and it appears the position will be filled in the immediate future. Difficulty was also encountered in the classification and filling of the Laboratory Mechanic and Engineering Technician positions.

Industrial Instruments, Inc. have been delayed approximately 5 months in the delivery of conductivity meters. This delay has placed an additional workload on the Field Station staff.

Salinity Control

Due to the difficulty in getting the Chief position classified in Washington, activities of this Section are approximately 6 months behind schedule. This position has yet to be classified at the proper grade. Complete staffing has been delayed pending establishment and filling of the Chief position.

Salinity Damage Assessment

Due to increased workload because of inability to fill key positions at the Field Station and Salinity Control, an additional workload placed on this Section has caused approximately a 3-month delay in planned activities.

I COMMUNICATION..

II PROJECT DESCRIPTION & MAP..............................

III CONSULTANTS AND COMMITTEES............................

IV ACTIVITIES & ACCOMPLISHMENTS, FY 1964..................

V PLANS AND SCHEDULE, FY 1965.............................

VI PLANS, FY 1966...

VII ORGANIZATION AND MANAGEMENT...........................

VIII. OTHER MATERIALS (Appendices)........................

1/7/64

Phoenix Field Station, FY 1965

The Phoenix Field Station will be occupied with the tasks of the type previously described throughout fiscal year 1965. Field surveys in the sub-basin of the lower Colorado River main-stem are expected to be completed by November 1964, and preparation of the Station's report on chemical quality of streams and sources of saline pollution will commence immediately thereafter. Target data for completion of this report is February 1965. Work in the sub-basins of the Gila and Little Colorado Rivers, which is scheduled to begin in April or May 1964, will progress in increasing tempo in fiscal year 1965, and should be nearly completed by July 1, 1965. Please refer to the graphical schedule in the included document "Phoenix Field Station Program" for details concerning the timing of the various operations.

Salinity Damage Assessment, FY 1965

Office studies leading to preparation of a report on salinity damages in the first area of concern, the lower Colorado main-stem sub-basin, should be completed by July 1964, and the report itself by September 1964. Thereafter the efforts of the Salinity Damage section will be extended to the remaining major watersheds of the lower basin of the Colorado River system, the Gila and Little Colorado. The elements of their task will remain as described previously, that is the determination of existing levels of water supply and quality, location and study of all available information on predicted future conditions, study of the physical and economic effects of water quality changes on the beneficial uses of water, and finally the estimate of expected economic losses from hard and saline water.

A schedule of operations has not yet been worked out in detail for the Gila and Little Colorado River sub-basins; however, it is expected that salinity damage assessment will be pursued approximately in phase with the work of the Phoenix Field Station. This will require completion of necessary office and field work for these two areas by July of 1965.

Biological Program

Effects of projected increases in salinity in the lower sub-basin on aquatic life will be evaluated, and damages assessed. This should be completed by mid-fiscal year for the Lower Sub-Basin.

Work will then be initiated in the Green River sub-basin of the Upper Basin. Available information will be secured from other agencies. Data previously developed by the Project will be utilized. Reconnaissance studies will be undertaken to explore and describe existing conditions. Follow-up investigations will be conducted as indicated by the results obtained from the foregoing activities. It is expected that this work will be completed by the end of the fiscal year.

Salinity Control, FY 1965

This section will evaluate salinity control measures for the significant sources of salinity in the Colorado River lower main-stem sub-basin, in phase with identification of these sources by the Field Station. Studies on technical feasibility and costs of control measures and improvements in this sub-basin should be completed (dependent on the completion of projections by the Economic Contractor) by the end of FY 1965. Similar studies will be initiated for the Gila and Little Colorado Sub-Basins.

1/10/64

Economic Contracts, FY 1965

In this fiscal year, the contractors expect to complete the study of the remaining two upper sub-basins, and then prepare several alternative models of the Basin as a whole by considering the adjustments that are theoretically feasible if water and economic activity are transferred from one Basin.

1/6/64

Radiological Surveillance Section

Program Element: Radium Monitoring Network

Data releases are planned on a quarterly basis during FY 1965.

Investigation will continue to determine feasibility and desirability of using RMN facilities for monitoring chemical quality of Basin waters as an aid to complete interpretation of radiological data.

RMN surveillance will continue, with a possible reduction in number of stations.

1/6/64

Program Element: Monticello Surveys

A report will be prepared outlining the extent of residual contamination over the period of record, and showing the beneficial effects of the AEC program to confine the tailings.

Brief annual follow-up surveys will be conducted, with limited sampling, to follow the decline of residual contamination in Montezuma Creek, as this is regarded as an excellent example of the potential effects of failure to make adequate provision for area protection at the sites of closed uranium mills.

1/6/64

Program Element: Delores-San Miguel River Sediment Surveys

Additional brief sampling will continue during FY 1965. Its purposes include surveillance and recording the possible decline of residual thorium contamination.

Program Element: Basinwide Sediment Surveys

Data from all surveys will be evaluated and possibly a report will be prepared, utilizing additional data collected after the last issued report.

A yearly collection (possibly in March before high flows) of sediments from approximately 30 stations throughout the Basin is planned, primarily for surveillance purposes.

1/6/64

Program Element: Lake Mead Sediment Survey

Laboratory analysis of samples will continue, and data correlation will be initiated. It is felt that analysis of these samples is not a high priority item, but can be deferred in order to fit the work into the laboratory schedule as other work permits.

Program Element: Uranium Mill Tailings Ultimate Disposal

It is not anticipated that the AEC and PHS will be able to reach an immediate agreement in the Spring of 1964 as to the degree of need for tailings pile protection or the means by which this may be best accomplished. Thus it is expected that the joint negotiations will continue through FY 1965.

It is not anticipated that any further extensive field surveys will be required during FY 1965, although limited field work to verify minor details, to develop data for a newly closed mill, or to test feasibility (in a very limited way) of a tailings treatment technique, may well prove desirable as the AEC-PHS negotiations continue.

1/6/64

Program Element: Uranium Mill Effluent Study

The data from the effluent surveys will be correlated and a determination made as to the degree of pollution from the existing isotope mixture. A report will be released on this activity during mid-FY 1965, or thereabouts.

1/6/64

Program Element: Crop Surveys

No activities are planned for FY 1965 as subsequent studies will be conducted under the Farm-Fertilizer Study.

1/6/64

Program Element: Farm-Fertilizer Study

Sample collection and analysis will continue. A report on findings will be prepared and released during FY 1965.

Pesticide Investigation, FY 1965 1/9/64

Activities through October 1964 will be the continuation of the FY 1964 activities. Additionally, some intensive sampling in small areas may be required, in order to more accurately pinpoint sources of pesticide contamination. Subsequent to completion of Main Stem sampling activities, and as laboratory capabilities permit, the investigation will be carried into the Little Colorado and Gila Sub-Basins. Further intensive sampling programs of short duration are anticipated in these areas. A limited survey of pesticides and herbicides in ground water will also be initiated.

During the latter portion of FY 1965, a comprehensive report covering the pesticide study will be written.

1/7/64

Anticipated Project Reports and Publications For FY 1965

A progress report will be issued late in FY 1965 concerning overall activities in the three lower sub-basins of the Colorado River. This report will include releases by the Field Station of data and activities of the various Sections.

Accomplishments thru June 30, 1965

The Field Station will complete a report on chemical quality of streams and sources of pollution in the Colorado River lower main-stem sub-basin with a target completion date of February 1965. Work that was initiated in 1964 on the sub-basins of the Gila and Little Colorado Rivers will continue, and should be completed by July 1, 1965.

The Salinity Damage Assessment Section has a target date of September 1964 to complete a report on salinity damage in the lower Colorado River main-stem sub-basin. Assessment of salinity damages in the Gila and Little Colorado River sub-basins will continue in phase with Field Station activities and office work should be completed by July 1, 1965.

Evaluation of salinity control measures applicable to salinity sources in the lower main-stem sub-basin of the Colorado River should be completed by the end of FY 1965. A report on technical feasibility and cost of control measures will be prepared. Studies in the Little Colorado and Gila sub-basin will be initiated.

Quarterly releases on RMN data will be issued. Concluding reports on the disposal of uranium mill tailings study and sediment survey results will be made.

Pesticide investigation started in 1964 will continue through October 1964. A comprehensive report covering the pesticide study will be written during the latter part of FY 1965.

In this fiscal year 1965, the contractors on the economic portion of the activity expect to complete the study of the remaining two upper sub-basins, and then prepare several alternative models of the Basin as a whole by considering the adjustments that are theoretically feasible if water and economic activity are transferred from one Basin.

II [illegible]

III CONSULTANTS AND CONTRACTS........

IV ACTIVITIES & ACCOMPLISHMENTS, FY [illegible]........

V PLANS AND SCHEDULE, FY 1965........

VI PLANS, FY 1966........

VII ORGANIZATION AND MANAGEMENT........

VIII OTHER MATERIALS (Appendices)........

COPY

UNITED STATES GOVERNMENT
MEMORANDUM

Colorado River Basin Water Quality Control Project, DWSPC, PHS, HEW
Rm. 415, Bldg. 22, Denver Federal Center, Denver, Colorado 80225

TO : Chief, Technical Services Branch
DWSPC, PHS, Washington

DATE: November 13, 1963

FROM : Project Director

SUBJECT: Budget Planning - FY 1966

The attached materials are submitted in accordance with your memorandum of November 6, 1963.

Charles E. Sponagle
Project Director

Enclosure (2 copies)

cc:
Chief, Enforcement Branch, DWSPC
RPD, DWSPC, Region VIII

1/2/64

COLORADO RIVER BASIN WATER QUALITY CONTROL PROJECT

BUDGET PLANNING - FISCAL YEAR 1966

Long-range Goal

There were two original objectives prescribed for undertaking by the Project. These two objectives were stated in the paper "Colorado River Basin Project on Water Quality Control" dated June 30, 1960, which summarized the proceedings of the first conference session.

1. "A determination of the specific pollutants and their concentrations which now exist, or which may reasonably be expected to exist in the immediate future resulting from various water uses within the Basin, and the establishment of priorities for developing data on, and securing needed remedial action at the most critical and pressing problem areas.
2. "A determination of methods for securing the best possible water quality for multiple water use and the development of a comprehensive plan and program of water quality control for multiple water use within the Basin which can serve as a guide for the conference in progress and other enforcement actions which may be instituted subsequently, and to State and Federal agencies having an interest in the prevention and control of water quality . . ."

The two most significant pollutants under consideration have been radioactive elements and total dissolved solids. Municipal and industrial wastes, other than radioactive, are of lesser importance. These will, of course, be considered in their proper perspective as the Project activities move forward. Radioactive pollution has been given priority until recently. Total dissolved solids are presently being given priority. Project activities have been reduced on radioactive pollutants to a surveillance type of activity.

A copy of the Summary of Conference (Fourth Session) on Pollution of Interstate Waters of the Colorado River and Its Tributaries, May 27 and 28, 1963 is attached. This indicates progress and continued need for the Project. The Project is being carried out under the provisions of section 8 of the Federal Water Pollution Control Act.

Program for Achieving Long-range Goal

Budgetary Projection

1964		1965		1966		1967		*1968	
Pos.	Amount	Pos.	Amount	Pos.	Amount	Pos.	Amount	Pos.	Amount
52	$706,000	52	$915,000	52	$710,000	52	$650,000	10	$130,000

*From: Highlight Statement
Comprehensive Program (undated) transmitted with Krause's memo of November 6, 1963.

Note: Funds include 15 percent Bureau-Division overhead.

The above estimates are based upon concentrating activities in the three lower sub-basins of the Colorado River (the Lower Main Stem, Little Colorado, and Gila) during fiscal years 1964 and 1965. The upper sub-basins of the Colorado River (the Green, Upper Main Stem, and San Juan) are programmed commencing fiscal year 1966. It is anticipated that the final report concerning Project activities will be completed during the last half of fiscal year 1967. Completion of planned activities in accordance with such scheduling is of course dependent upon adequate budgetary support.

Relationship of 1966 Program to Long-range Goal

It is anticipated that commencing FY 1966, the Project activities will be centered in the three sub-basins in the Upper Colorado River Basin previously mentioned. The activities during this fiscal year will concentrate primarily on three general objectives:

1. To assess the nature and magnitude of the salinity problem in the main stem of the Colorado River and its tributaries.
2. To investigate and evaluate feasible methods of controlling and minimizing salinity concentrations and loads in the River, and
3. To evaluate the net basinwide economic benefits associated with various degrees of salinity control.

1/2/64

SUMMARY OF CONFERENCE
(FOURTH SESSION)

POLLUTION OF INTERSTATE WATERS
of the
COLORADO RIVER AND ITS TRIBUTARIES
(COLORADO-UTAH-ARIZONA-NEVADA-
CALIFORNIA-NEW MEXICO-WYOMING)

May 27 and 28, 1963

The fourth session of the Conference in the Matter of Pollution of the Interstate Waters of the Colorado River and its Tributaries (Colorado-Utah-Arizona-Nevada-California-New Mexico-Wyoming) was held on May 27 and 28, 1963 in the San Diego area of California, under the provisions of section 8 of the Federal Water Pollution Control Act (33 U.S.C. 466 et seq.). The first session was held on January 13, 1960 in Phoenix, Arizona; the second session was held on May 11, 1961, in Las Vegas, Nevada; and the third session on May 9 and 10, 1962, in Salt Lake City, Utah.

The Colorado River rises high in the snow-capped Rocky Mountains of north central Colorado near the Continental Divide. It flows generally southwesterly for some 1,400 miles and empties into the Gulf of California in Mexico. The river flows across Colorado into Utah and thereon to form parts of the boundaries between Arizona and Nevada, and Arizona and California. It has some sixty tributaries and drains not only parts of the five States named but also parts of New Mexico and Wyoming.

The following Conferees representing the State Water Pollution Control Agencies of Colorado, Utah, Arizona, Nevada, California, New Mexico, and Wyoming, and the U. S. Department of Health, Education and Welfare, attended the fourth session of the Conference:

Mr. Paul R. Bonderson	California Water Quality Control Board Sacramento, California
Mr. Charles G. Caldwell	New Mexico Department of Public Health Santa Fe, New Mexico
Mr. William N. Gahr	Colorado Department of Public Health Denver, Colorado
Mr. George W. Marx	Arizona Department of Public Health Phoenix, Arizona
Mr. Lynn M. Thatcher	Utah Water Pollution Control Board Salt Lake City, Utah
Mr. Arthur E. Williamson	Wyoming Department of Public Health Cheyenne, Wyoming
Mr. George E. Shaw	Nevada State Department of Health Reno, Nevada
Lester M. Klashman	U. S. Department of Health, Education, and Welfare, Denver, Colorado
Murray Stein, Chairman	U. S. Department of Health, Education, and Welfare, Washington, D.C.

Also participating in the fourth session of the Conference were the following:

Robert G. Beverly	Union Carbide Nuclear Company Grand Junction, Colorado
Dallas E. Cole	Colorado River Board of California Los Angeles, California
June W. Crawford	Texas Gulf Sulphur Company Moab, Utah
William T. Davoren	U. S. Department of Interior Salt Lake City, Utah
Joseph W. Fitzpatrick	U. S. Department of Health, Education, and Welfare, Denver, Colorado

Davis C. Holder	Engineering Consultant, City of Moab, Utah Grand Junction, Colorado
Maurice Langley	Bureau of Reclamation, U. S. Department of Interior Washington, D. C.
Donald Nussbaumer	U.S. Atomic Energy Commission Washington, D. C.
Travis H. Redman	Texas-Zinc Minerals Corporation Grand Junction, Colorado
Arthur Schoen	U.S. Atomic Energy Commission Washington, D.C.
Charles E. Sponagle	U.S. Department of Health, Education, and Welfare Denver, Colorado
Clyde E. Stewart	U.S. Department of Agriculture Logan, Utah
Kenneth E. Tame	Bureau of Mines, U.S. Department of Interior Salt Lake City, Utah
Dr. E.C. Tsivoglou	U.S. Department of Health, Education, and Welfare, R.A. Taft Sanitary Engineering Center Cincinnati, Ohio

The Chairman of the Conference pointed out that:

1. Under the Federal Water Pollution Control Act (33 U.S.C. 466 et seq.), pollution of interstate waters which endangers the health or welfare of persons in a State other than the one in which the discharge originates is subject to abatement under the procedure prescribed in section 8 of the Federal Act.
2. The first step of this procedure is the calling of a conference.
3. The purpose of the conference is to bring the States and the

U.S. Department of Health, Education, and Welfare together to review the situation, to lay a basis for future action by all parties concerned and to give States and localities an opportunity to take any indicated remedial action under State and local law.

4. At the first session of the Conference on the Colorado River and its tributaries, held on January 13, 1960, in the Phoenix Library Auditorium, Phoenix, Arizona, the U. S. Department of Health, Education, and Welfare agreed to undertake in cooperation with the States and other Federal agencies an investigation and study to define the type of interstate pollution problems that might exist in the interstate waters of the Colorado River and its tributaries, to include, among other things, a determination of specific pollutants and their concentration, and methods of securing the best possible water quality for multiple uses. The U. S. Department of Health, Education, and Welfare further agreed to present a detailed proposed plan of the study and investigation to the States and Federal agencies for review and comments.
5. At the second session of the Conference, held on May 11, 1961, at the Stardust Auditorium, Las Vegas, Nevada, the status of action taken on the study and investigation was reported.
6. At the third session of the Conference held on May 9 and 10, 1962 at the Auditorium, New State Office Building (Capital Hill), Salt Lake City, Utah, the status of the investigation,

study, and remedial action taken was reported.

At the fourth session of the Conference, the status of the investigation, study, and remedial action taken was reported as follows:

I. A. Radium levels of the Colorado River and its tributaries have been markedly reduced since the Project was initiated and are now considerably below the maximum permissible concentrations recommended in the Public Health Service Drinking Water Standards.

B. Increasing total dissolved solids content of the Colorado River Basin waters is a major water quality problem existing in the Basin and should receive principal emphasis in the Project's investigative program.

II. In this next year the Colorado River Basin Project will conduct the following activities:

A. Investigation not only of pollution sources and concentrations, but also determination of feasible measures for protecting water quality for all uses to permit maximum economic growth and development in the Colorado River Basin. Principal emphasis will be given to studies of salinity (total dissolved solids) conditions in the Basin, specifically:

1. Investigation and characterization of major sources causing salinity increases. Among the sources to be investigated are:

    a. Natural sources such as springs and ground water reservoirs

    b. Waste discharges from municipalities and industries

c. Return irrigation waters

d. Consumptive uses

e. Water losses due to trans-Basin diversions

f. Water losses due to evaporation in reservoirs and canals, and evapo-transpiration

2. Investigation of feasible measures by means of which salinity increases could be reduced.

3. Comparative projection of salinity conditions where no reductions are effected and conditions to be expected with various methods of salinity reduction in effect.

4. Determination of economic benefits and costs at various levels of salinity concentration.

5. Determination of salinity concentrations at which maximum net economic benefits would accrue.

B. Continuation of the Radium Monitoring Network for detection of accidental spills and evaluation of average radioactivity levels throughout the Basin. In addition to routine sampling, the following specialized activities will be undertaken:

1. Extension of the analyses at selected stations to include other significant radioisotopes associated with uranium milling such as gross alpha activity, uranium, lead-210, and thorium.

2. Evaluation of radioactive fallout in Basin waters by analysis of strontium-90, gross beta activity, and a gamma scan at selected Network stations.

3. Thorough inorganic chemical analyses at selected Network stations to aid in making a complete interpretation of

the radioactive water quality data.

C. Sediment monitoring for gross alpha activity and radium-226 at a reduced number of sampling points.

D. Studies of residual radium-226 contamination at selected farms and the related effect of use of phosphate fertilizers on feed crops and milk.

E. Joint study with the Atomic Energy Commission to develop proposals for the ultimate disposal of uranium mill tailings, to be considered by the responsible Federal, State, and local agencies, and the uranium milling industry.

F. Sampling of all uranium mill effluents for lead-210 and thorium analyses, with additional sampling where significant contributions are found.

G. Additional sampling and monitoring of San Miguel River sediments in the immediate vicinity of Uravan, Colorado, to evaluate extent of thorium contamination.

H. Additional sampling of Montezuma Creek water and sediments at Monticello, Utah, to evaluate existing stream quality and effect of site improvement.

I. Preparation by the project staff for submission to the technical committee, and when possible to the conferees, of a set of basic principles to be used in the formulation of a comprehensive pollution control plan. This comprehensive plan is to take into account other factors in addition to those of salinity and radioactivity now being considered.

APPENDIX A

Those in attendance at the fourth session of the Conference were the following:

Department of Health, Education, and Welfare:

Kenneth E. Biglane	Washington, D. C.
Lisle C. Carter, Jr.	Deputy Assistant Secretary Washington, D. C.
John G. Connor	Salt Lake City, Utah
James B. Coulter	Washington, D. C.
John G. Detmer	Denver, Colorado
Paul W. Eastman	San Francisco, California
William C. Galegar	Dallas, Texas
Croswell Henderson	Salt Lake City, Utah
Dr. W. M. Ingram	Cincinnati, Ohio
Peter Kuh	Washington, D. C.
Morton A. Lebow	Washington, D. C.
Charles H. Petersen	Denver, Colorado
Mrs. Rheta Piere	Washington, D. C.
Albert L. Platz	Window Rock, Arizona
Frank H. Rainwater	Washington, D. C.
D. E. Rushing	Salt Lake City, Utah
Jay S. Silhanek	San Francisco, California
Irving M. Terzich	San Francisco, California

Representatives of the Federal Government:
U.S. Department of the Interior

Ernest E. Allen	Denver, Colorado
Floyd A. Henderson	San Francisco, California

Burdge Irelan	Yuma, Arizona
Cecil B. Jacobson	Salt Lake City, Utah
R. B. Maurer	San Francisco, California
C. C. McDonald	Yuma, Arizona
Stewart F. Mulford	San Diego, California
Arthur M. Piper	Menlo Park, California
Jack W. Rodner	Boulder City, Nevada
U. S. Atomic Energy Commission	
Donald F. Harmon	Washington, D. C.
U. S. Department of Agriculture	
Kirk M. Sandals	Berkeley, California
Corps of Engineers	
Joseph McCoy	Los Angeles, California
Representatives of State and City Governments:	
Paul L. Billhymer	Upper Colorado River Commission Salt Lake City, Utah
Norman G. Boyd	Mayor City of Moab, Utah
W. S. Gookin	Arizona Interstate Stream Commission Phoenix, Arizona
Ival V. Goslin	Upper Colorado River Commission Salt Lake City, Utah
Ralph E. Graham	San Diego, California
Lynne C. Larsen	California Regional Water Pollution Control Board #4 Los Angeles, California
Gelbert W. Lee	Colorado River Board of California Los Angeles, California
Robert P. Lowe	New Mexico Department of Public Health Santa Fe, New Mexico

W. Don Maughan	Colorado River Board of California Los Angeles, California
Arthur Swajian	Colorado River Basin Regional Water Pollution Control Board Indio, California
D. B. Willets	California Department of Water Resources Los Angeles, California
Dr. Bernard Udis	University of New Mexico Albuquerque, New Mexico

Representatives of Industry:

Harry Barber	Boyle Engineering San Diego, California
Frank E. Brown	Climax Molybdenum Company Climax, Colorado
H. M. Crooker	Con. Engineer La Jolla, California
Ray Hebert	Los Angeles Times Los Angeles, California
T. F. Izzo	Atlas Minerals, Division of Atlas Corp. Moab, Utah
R. E. Polenske	Arizona Water Company Phoenix, Arizona

I COMMUNICATION..

II PROJECT DESCRIPTION & MAP............................

III CONSULTANTS AND COMMITTEES...........................

IV ACTIVITIES & ACCOMPLISHMENTS, FY 1964............

V PLANS AND SCHEDULE, FY 1965.........................

VI PLANS, FY 1966.....................................

VII ORGANIZATION AND MANAGEMENT.......................

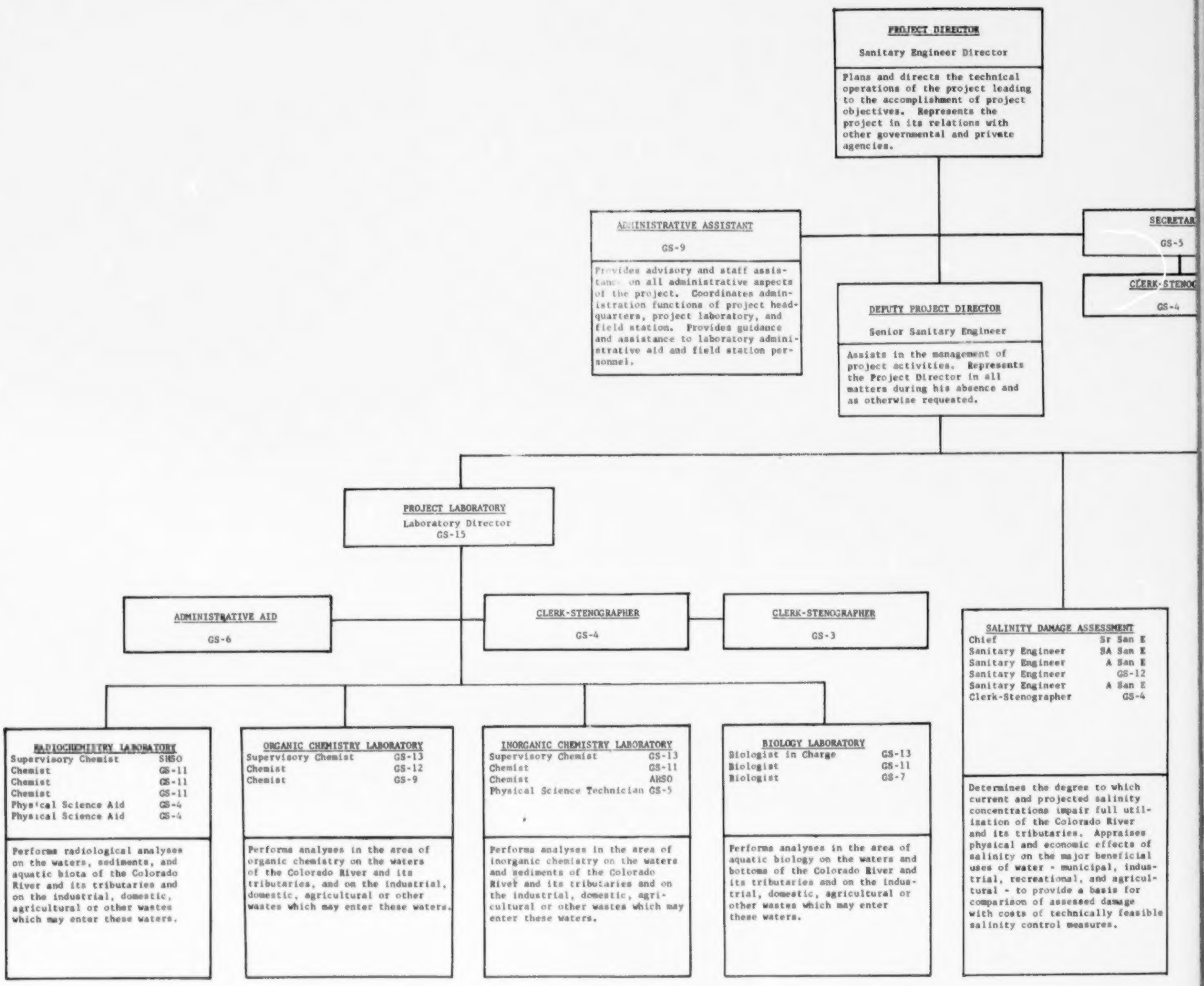
VIII OTHER MATERIALS (Appendices).....................

1/7/64

Project Schedule

Several months ago, a modified critical path was prepared showing major Project activities. This has been brought along for discussion purposes.

Project activities have been previously explained. It is or should be apparent that additional staffing, planning, and scheduling of activities will have to progress further before a detailed critical path can be formulated, or the present one corrected as to scheduling. This is the reason that copies of the chart have not been made available at this time.



PROJECT DIRECTOR

Sanitary Engineer Director

Plans and directs the technical operations of the project leading to the accomplishment of project objectives. Represents the project in its relations with other governmental and private agencies.

ADMINISTRATIVE ASSISTANT

GS-9

Provides advisory and staff assistance on all administrative aspects of the project. Coordinates administration functions of project headquarters, project laboratory, and field station. Provides guidance and assistance to laboratory administrative aid and field station personnel.

SECRETAR

GS-5

CLERK-STENOG

GS-4

DEPUTY PROJECT DIRECTOR

Senior Sanitary Engineer

Assists in the management of project activities. Represents the Project Director in all matters during his absence and as otherwise requested.

PROJECT LABORATORY

Laboratory Director

GS-15

ADMINISTRATIVE AID

GS-6

CLERK-STENOGRAPHER

GS-4

CLERK-STENOGRAPHER

GS-3

RADIOCHEMISTRY LABORATORY

Supervisory Chemist	SHSO
Chemist	GS-11
Chemist	GS-11
Chemist	GS-11
Physical Science Aid	GS-4
Physical Science Aid	GS-4

Performs radiological analyses on the waters, sediments, and aquatic biota of the Colorado River and its tributaries and on the industrial, domestic, agricultural or other wastes which may enter these waters.

ORGANIC CHEMISTRY LABORATORY

Supervisory Chemist	GS-13
Chemist	GS-12
Chemist	GS-9

Performs analyses in the area of organic chemistry on the waters of the Colorado River and its tributaries, and on the industrial, domestic, agricultural or other wastes which may enter these waters.

INORGANIC CHEMISTRY LABORATORY

Supervisory Chemist	GS-13
Chemist	GS-11
Chemist	AHSO
Physical Science Technician	GS-5

Performs analyses in the area of inorganic chemistry on the waters and sediments of the Colorado River and its tributaries and on the industrial, domestic, agricultural or other wastes which may enter these waters.

BIOLOGY LABORATORY

Biologist in Charge	GS-13
Biologist	GS-11
Biologist	GS-7

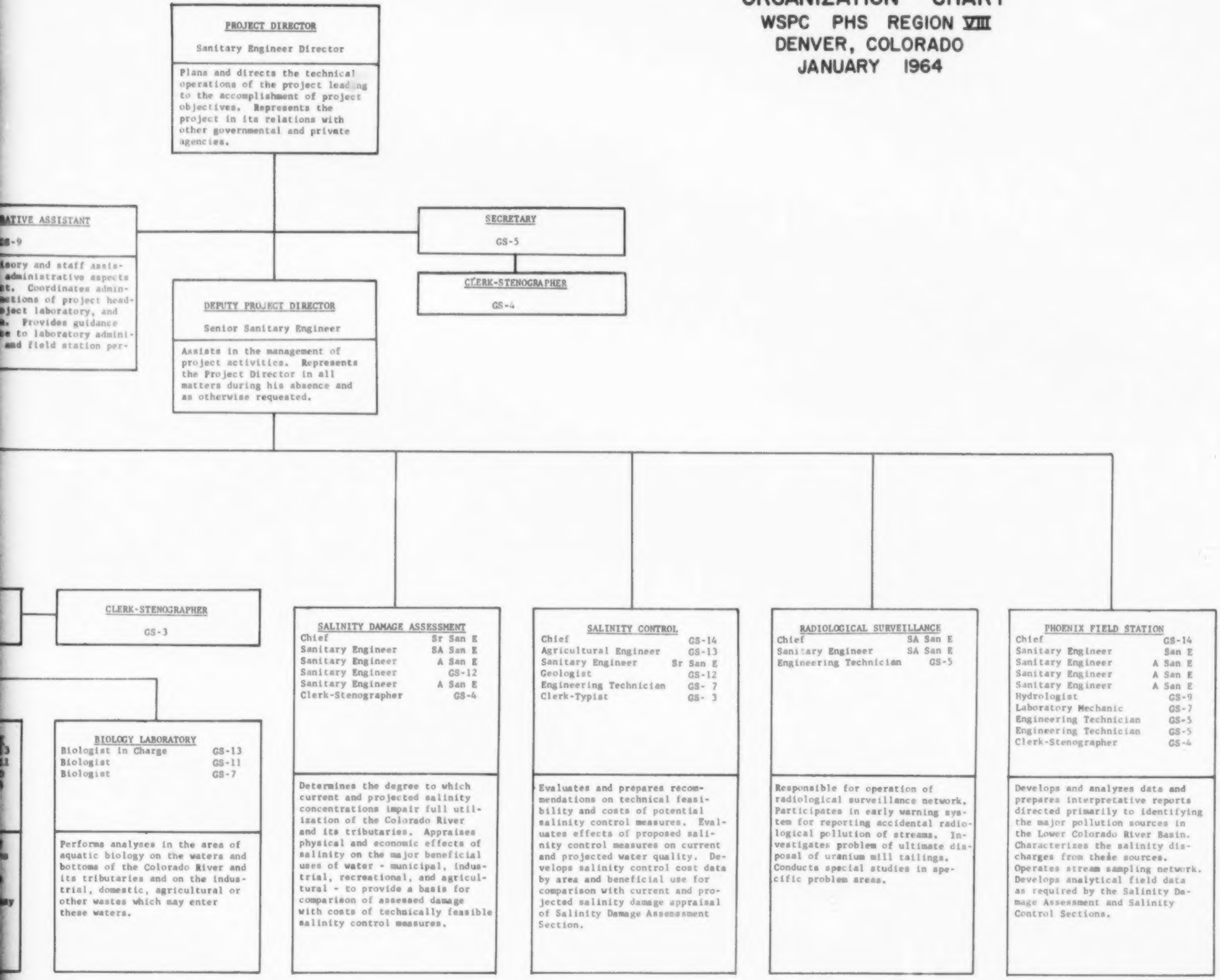
Performs analyses in the area of aquatic biology on the waters and bottoms of the Colorado River and its tributaries and on the industrial, domestic, agricultural or other wastes which may enter these waters.

SALINITY DAMAGE ASSESSMENT

Chief	Sr San E
Sanitary Engineer	SA San E
Sanitary Engineer	A San E
Sanitary Engineer	GS-12
Sanitary Engineer	A San E
Clerk-Stenographer	GS-4

Determines the degree to which current and projected salinity concentrations impair full utilization of the Colorado River and its tributaries. Appraises physical and economic effects of salinity on the major beneficial uses of water - municipal, industrial, recreational, and agricultural - to provide a basis for comparison of assessed damage with costs of technically feasible salinity control measures.

COLORADO RIVER BASIN PROJECT
ORGANIZATION CHART
WSPC PHS REGION VIII
DENVER, COLORADO
JANUARY 1964



PROJECT DIRECTOR

Sanitary Engineer Director

Plans and directs the technical operations of the project leading to the accomplishment of project objectives. Represents the project in its relations with other governmental and private agencies.

ATIVE ASSISTANT

S-9

isory and staff assis- administrative aspects t. Coordinates admin- tions of project head- ject laboratory, and . Provides guidance e to laboratory admini- and field station per-

SECRETARY

GS-5

CLERK-STENOGRAPHER

GS-4

DEPUTY PROJECT DIRECTOR

Senior Sanitary Engineer

Assists in the management of project activities. Represents the Project Director in all matters during his absence and as otherwise requested.

CLERK-STENOGRAPHER

GS-3

BIOLOGY LABORATORY

Biologist in Charge	GS-13
Biologist	GS-11
Biologist	GS-7

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SALINITY DAMAGE ASSESSMENT

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SALINITY CONTROL

Chief	GS-14
Agricultural Engineer	GS-13
Sanitary Engineer	Sr San E
Geologist	GS-12
Engineering Technician	GS- 7
Clerk-Typist	GS- 3

Evaluates and prepares recommendations on technical feasibility and costs of potential salinity control measures. Evaluates effects of proposed salinity control measures on current and projected water quality. Develops salinity control cost data by area and beneficial use for comparison with current and projected salinity damage appraisal of Salinity Damage Assessment Section.

RADIOLOGICAL SURVEILLANCE

Chief	SA San E
Sanitary Engineer	SA San E
Engineering Technician	GS-5

Responsible for operation of radiological surveillance network. Participates in early warning system for reporting accidental radiological pollution of streams. Investigates problem of ultimate disposal of uranium mill tailings. Conducts special studies in specific problem areas.

PHOENIX FIELD STATION

Chief	GS-14
Sanitary Engineer	San E
Sanitary Engineer	A San E
Sanitary Engineer	A San E
Sanitary Engineer	A San E
Hydrologist	GS-9
Laboratory Mechanic	GS-7
Engineering Technician	GS-5
Engineering Technician	GS-5
Clerk-Stenographer	GS-4

Develops and analyzes data and prepares interpretative reports directed primarily to identifying the major pollution sources in the Lower Colorado River Basin. Characterizes the salinity discharges from these sources. Operates stream sampling network. Develops analytical field data as required by the Salinity Damage Assessment and Salinity Control Sections.

1/2/64

FUNCTIONAL STATEMENTS, COLORADO RIVER PROJECT, 1964 FY

The program is oriented primarily toward the problem of stream salinity.

The radiochemical surveillance program stemming from previous studies is being continued. Exploratory investigations of pesticide content of river waters are being undertaken in selected areas.

The broad objectives in the salinity studies are to ascertain present and probable future salinity concentrations in surface waters throughout the Colorado River Basin, to identify present and probable future major sources of salinity concentrations, to determine the present and probable future physical and economic significance of salinity content of surface waters with and without the consideration of salinity control measures, and to recommend various measures and/or approaches whereby salinity sources can be controlled. The end result of the study is a determination of the water quality and ways of obtaining it, which will support optimum development in the Lower Basin with consideration given to the economics of control measures related to the benefits derived from reduced salinity.

The sciences of hydrology and agricultural engineering are involved in their broadest aspects in this water-short and agrarian area.

Initially attention will be concentrated in the drainage and water-use area of the Lower Basin -- Arizona, California, and Nevada.

An important part of the program will involve the assembly and evaluation of existing data from Federal, state, local, and private agencies in order to avoid duplication of effort in data development. A considerable amount of information concerning salinity in the Colorado River Basin already exists; however, it is necessary that this be handled in a manner consistent with and oriented toward Project objectives.

The Salinity Damage Assessment Section determines the degree to which salinity impairs full utilization of the Colorado River and its tributaries. This involves such things as the effect of salinity on fish and other aquatic life, decreases in yield of irrigated crops, inability to grow certain crops, loss of irrigated lands from production, potential of bringing marginal lands under irrigation, cost of treatment and maintenance in municipal water supplies, and impact on industrial development.

The Salinity Control Section evaluates and prepares recommendations on the technical feasibility and costs of various potential salinity-control measures to reduce or minimize salinity loadings and concentrations in the river system. Potential methods of control include (a) control of natural brines entering the mainstem and tributaries; (b) dilution of salts by regulating streamflow, which involves a network, and operating schedules, of reservoirs; (c) controlled discharge of salts from natural sources to coincide with above-average streamflows so as to reduce peak salinity concentrations from present levels; (d) reduce water losses from evaporation and evapotranspiration; (e) decrease the contribution of highly saline ground water to the streams by control of ground water hydraulics; for example, minimizing the use of excess irrigation water and decreasing canal conveyance losses which percolate to and raise the ground water table; (f) limit the practice of using water in excess of needs for various purposes; and (g) change water uses from those contributing large amounts of salinity to the stream to others contributing less.

The degree of water quality improvement associated with each control method will be appraised.

The Radiological Surveillance Section operates the radiological surveillance network. This activity is the outgrowth of the implementation of control measures at uranium mills and includes an early warning system for accidental spills and continuing surveillance of radiological stream quality. Also included under this activity are special studies of radiological pollution in certain specific areas of the basin, and consideration of the problem of ultimate disposal of uranium mill tailings.

The Field Station (Phoenix, Arizona) develops and analyzes data and prepares interpretative reports directed primarily to identifying the major salinity sources in the Lower Colorado River Basin and characterizing the salinity discharges from these sources. Involved in this activity are the operation of a stream sampling network integrated with flow-gaging station, the conduct of intensive studies in selected areas, and the collection of relevant information on environmental factors such as rainfall, runoff, geology, soil types, ground water conditions, irrigation practices, and other water uses. Irrigation drainage returns, springs, brine seeps, and the natural products of weathering of rocks and soils are included as well as water losses that degrade the quality of the remaining supply. Much of the foregoing information is available and will be secured from appropriate sources. The Section is also responsible for the conduct of exploratory studies of pesticide content of river waters in the Lower Basin.

The Project Laboratory (Salt Lake City, Utah) provides analytical support and consultation on natural science aspects of the Project, such as radiochemistry, bacteriology, aquatic biology, inorganic and organic chemistry including pesticides, herbicides, and other inorganic and organic chemicals which may be harmful to human and/or aquatic life or degrade water quality so as to seriously interfere with legitimate water uses.

Division of Water Supply and Pollution Control
Technical Services Branch

Colorado River Basin Water Quality Control Project
(Enforcement)
January 6, 1964

Title	Grade	Series	Pos. No.	Name	Duty Station
Project Direction					
Project Director	SEDIR(T)			Sponagle, C.E.	Denver, Colo.
Deputy Project Director	SSE(T)			Fitzpatrick, J.W.	"
Administrative Assistant	GS-9	341	BSS-4179	Gullickson, H.N.	"
Secretary	GS-5	318	161	Pearson, Donna J.	"
Clerk-Stenographer	GS-4	312	185	Sneddon, Evelyn K.	"
Salinity Damage Assessment					
Chief	SSE(R)			Coffey, Philip J.	"
Sanitary Engineer	SASE(R)(T)			Yorke, Charles A.	"
Sanitary Engineer	ASE(R)(T)			Heaney, James P.	"
Sanitary Engineer	GS-12			Vacant	"
Sanitary Engineer	ASE(R)(T)			Yonikas, Patrick J.	"
Clerk-Stenographer	GS-4	312	256	Squires, Marjorie R.	"
Salinity Control					
Chief (Hydrologist)	GS-14	1301		Vacant	"
Agricultural Engineer	GS-13			Vacant	"
Sanitary Engineer	SSE(R)(T)			Jeffrey, Edgar A.	"
Geologist	GS-12	1350	BSS-5179	Spiegel, Sidney	"
Engineering Technician	GS-7	802	235	Vacant	"
Clerk-Typist	GS-3	322	215	Spedon, Mary G.	"
Radiological Surveillance					
Chief	SASE(R)(T)			Wruble, Donald T.	"
Sanitary Engineer	SASE(R)(T)			Dawson, Herbert M.	"
Engineering Technician	GS-5	802	171	Vacant	"
Phoenix Field Station					
Chief	GS-14	819		Vacant	Phoenix, Ariz.
Sanitary Engineer	SE(T)			Reed, Lloyd A.	"
Sanitary Engineer	ASE(R)(T)			Blackman, W. C.	"
Sanitary Engineer	ASE(R)(T)			Adler, Irwin B.	"
Sanitary Engineer	ASE(R)(T)			Todd, Allen W.	"
Hydrologist	GS-9	1301		Vacant	"
Laboratory Mech. (Gen.)	GS-7	1610	EH-63-316	Burns, John F.	"
Engineering Technician	GS-5	802	267	Korolevich, E. R.	"
Engineering Technician	GS-5	802	267-IA	Vacant	"
Clerk-Stenographer	GS-4	312	256	Leaman, Virginia E.	"

Division of Water Supply and Pollution Control
Technical Services Branch

Colorado River Basin Water Quality Control Project
(Enforcement)
January 6, 1964

Title	Grade	Series	Pos. No.	Name	Duty Station
Salt Lake City Laboratory					
Laboratory Direction					
Laboratory Director	GS-15	1320	BSS-3631	Rushing, D. E.	Salt Lake City
Administrative Aid	GS-6	301	194	Zeman, Blanche	"
Clerk-Stenographer	GS-4	312	173	Kueffner, Eileen	"
Clerk-Stenographer	GS-3	312	202	Madsen, Janice C.	"
Biology Laboratory					
Biologist-in-Charge	GS-13	401	BSS-4128	Henderson, Croswell	"
Biologist	GS-11	401		Vacant	"
Biologist	GS-7	401	BSS-4949	Johnson, Clark D.	"
Inorganic Chemistry Laboratory					
Supervisory Chemist	GS-13	1320	BSS-4406	Connor, John G.	"
Chemist, Analytical	GS-11	1320	BSS-4409	Jarrell, Raymond E.	"
Chemist, Analytical	AHSO(R)(T)			Freking, Ronald J.	"
Physical Science Tech.	GS-5	1311	269	Sawtelle, D. C.	"
Organic Chemistry Laboratory					
Supervisory Chemist	GS-13	1320	BSS-4408	Julian, E. C.	"
Chemist, Analytical	GS-12	1320	BSS-5055	Woodward, Theodore	"
Chemist, Analytical	GS-9	1320	BSS-4410	Keisler, Hans	"
Radiochemistry Laboratory					
Supervisory Chemist (General Radiochemistry)	SHSO(R)			Talvitie, Niilo A.	"
Chemist, Analytical	GS-11	1320	BSS-4692	Garcia, William J.	"
Chemist, Analytical	GS-11	1320	BSS-4692IA	Demint, Robert J.	"
Chemist, Analytical	GS-11	1320	BSS-4692IA	Clark, Don A.	"
Physical Science Aid	GS-4	1311	170	Sorenson, Boyd C.	"
Physical Science Aid	GS-4	1311	247	*Farmer, Richard J.	"

*Returns from military duty. Est. EOD 2/3/64

1-2-64

Division of Water Supply and Pollution Control
Technical Services Branch

Colorado River Basin Water Quality Control Project
(Enforcement)

PERSONNEL NEEDS
January 6, 1964

Title	Grade	Series	Job Desc. Status			Position		Duty Station	Estimated EOD
			Prep.	App.	Class.	Auth.	Funded		
Salinity Damage Assessment									
Sanitary Engineer	GS-12		X			X	X	Denver, Colo.	3/1/64
Salinity Control									
Chief (Hydrologist)	GS-14	1301	X	X		X	X	"	4/1/64
Agric. Engineer	GS-13		X			X	X	"	4/1/64
Eng. Technician	GS-7	802	X	X	X	X	X	"	3/1/64
Radiological Surveillance									
Eng. Technician	GS-5	802	X	X	X	X	X	"	3/1/64
Phoenix Field Station									
Chief	GS-14	819	X	X		X	X	Phoenix, Arizona	1/1/64
Hydrologist	GS-9	1301	X	X		X	X	"	3/1/64
Engineering Tech.	GS-5	802	X	X	X	X	X	"	1/1/64
Salt Lake City Laboratory									
Biologist	GS-11	401	X	X		X	X	Salt Lake City	2/1/64

1/6/64

ESTIMATED WORKING BUDGET PLAN

Fiscal Year 1964

Region and Location Region VIII
Denver, Colorado
1964 Allotment No. 4-3158

Program/Project No. 558
and Title Colorado River Basin Water
Quality Control Project

		1964 Estimate	
		No. Positions	Amount
11	Personnel Compensation (Total)	50	$308,404
	Compensation other than consultants		-0-
	Summer employment		-0-
	Consultants' fees		-0-
12	Personnel benefits		51,533
21	Travel		
	Change of station including dependents and dislocation allowance		6,500
	Car rental (all sources)		1,500
	Other TDY		43,000
22	Transportation of things		
	Change of station		7,500
	Other		17,000
23	Rents, communications & utilities (Do not include space rental)		7,500
24	Printing and reproduction		3,000

25	Other Services		
	Contracts		
	ERS, Dept. of Agriculture		$ 50,000
	Other		27,000
	University of Utah (Bio. Ident.)	$ 2,000	
	Laundry services (Laboratory)	600	
	Soft water service (Laboratory)	350	
	Sample collectors (Rad. Surveillance)	8,000	
	Sample collectors (Field Station)	4,000	
	Federal Employee Health (PHS)	225	
	Stream measurements (USGS)	5,000	
	ADP services (SEC, PHS)	5,000	
	Instrument maintenance (Laboratory)	1,000	
	Tuition, fees, & related services	825	
26	Supplies and materials		25,063

31 Equipment Total $ 32,000.00

Project Headquarters		
Reproduction machine		$ 432.00
Equipment parts (Rad. Surv.)		500.00
	Sub-Total	932.00
Laboratory		
Accessory for Model B Spectrophotometer		148.00
Ion Exchange columns for separation of radioactive isotopes		150.00
Replacement parts and repairs to instruments (not under contract)		500.00
Scaler for use with scintillation attachment		1,000.00
Ball mill for pesticide work on soils		240.00
Refrig. cabinet for storage of dry ice		165.00
Special evaporation equipment (pesticides)		150.00
Tissue grinders and sieves (pesticides)		165.00
Oxygen flask (pesticides)		206.00
Gas chromatography accessory (pesticides)		1,700.00
Multiple reflectance attachment for infrared spectrophotometer (pesticides)		1,100.00
Absorption cells for DK2 spectrophotometer		234.00
Polarographic oxygen analyzer		200.00
Electrodes, filtration apparatus		495.00
Miscellaneous equipment		1,433.00
	Sub-Total	7,936.00
Field Station		
Boxes for conductivity meters		1,200.00
Conductivity meters		20,000.00
Replacement parts for meters		1,500.00
Reproduction machine		432.00
	Sub-Total	23,132.00

Grand Total $530,000.00

1/6/64

ESTIMATED WORKING BUDGET PLAN BY QUARTER

Fiscal Year 1964

Region and Location Region VIII - Denver, Colorado

Program/Project No. 558
and Title Colorado River Basin Water Quality Control Project

1964 Allotment No. 4-3158

	1st Half (Actual Funds Obligated)	3rd Qtr.	4th Qtr.	Total
Personnel compensation and benefits	$160,775	$99,581	$99,581	$359,937
Travel	18,170	16,415	16,415	51,000
Contracts Dept. of Agriculture	25,000	12,500	12,500	50,000
Other	38,807	40,128	40,128	119,063
Totals	$242,752	$168,624	$168,624	$580,000

Note: Since there is a carry-over in unobligated funds from the first half of $30,547 no change in quarterly apportionment is necessary. Please see next page for analysis. Funds under Other unevenly apportioned because of delay in ordering certain equipment and supplies pending advice of budget from the Division and increased activities of the Field Station during the second half.

1/6/64

BUDGET ANALYSIS
Fiscal Year 1964

	Obligated	Unobligated
Personnel Compensation	$ 136,249.80	$ 89.20
Personnel Benefits	24,524.99	52.01
Travel	18,170.95	9,726.05
Other	63,806.96	20,680.04
Totals	$242,752.70	$30,547.30

Allowance	1st half	3rd qtr.	4th qtr.	Total
Distribution	$273,300	$158,700	$148,000	$580,000
Less Obligations	242,752			
Available subsequent quarter	$ 30,548			

Personnel Services, FY 1964 (1st and 2nd Quarters) 1/3/64

Region and Location Region VIII, Denver, Colorado

Program/Project No. 558
and Title Colorado River Basin Water Quality Control Project

1964 Allotment No. 4-3158

Position Title	Encumbent	Grade	Compensation	Benefits	Remarks
Project Direction					
Project Director	Sponagle, Charles E.	SEDIR(T)+16	$ 5,040.00	$ 1,308.00	
Deputy Proj. Director	Fitzpatrick, J. W.	SSE+16	4,520.00	1,259.00	+18/10/63
Admin. Officer	Petersen, Charles H.	GS-10/5	1,114.40	87.29	Trans. cob 8/16/63
Admin. Assistant	Gullickson, H. N.	GS-9/1	3,292.56	266.75	Trans. Lab. 9/29/63, GS7-4
Secretary	Phillips, Wilma	GS-5/4	777.60	53.54	Trans. cob 8/23/63
Clerk-Stenographer	Pearson, Donna J.	GS-4/6	2,449.92	208.67	
Clerk-Stenographer	Sneddon, Evelyn K.	GS-4/3	2,238.72	177.80	
Economist	Collins, George G.	GS-11/2	800.00	63.73	Trans. cob 8/4/63
		Sub-total	20,233.20	3,424.78	
		Total	23,657.98	14.96%	Salary Costs
Salinity Damage Assessment					
Chief	Coffey, Philip J.	SSE+18	4,650.00	1,240.00	
Sanitary Engineer	Yorke, Charles A.	SASE-2	978.00	570.00	EOD 10/63
Sanitary Engineer	Heaney, James P.	ASE-2	1,556.00	1,064.00	
Sanitary Engineer	Yonikas, Patrick J.	ASE-2	778.00	457.00	EOD 10/63
Clerk-Stenographer	Squires, Marjorie	GS-4/6	1,800.32	123.08	EOD 8/18/63
Sanitary Engineer	Pahren, Herbert	SE	270.00	113.00	Trans. 7/63
Sanitary Engineer	Struzeski, Edwin J.	SE+6	1,395.00	630.00	Trans. 10/63
	Schillinger, George	COSTEP	222.00	141.00	Comm. Inactive dated 8/63
Engineering Technician	Rivenes, Roger	GS-7/2	1,049.52	87.19	Res. cob 9/5/63
		Sub-total	12,698.84	4,425.27	
		Total	17,124.11	10.82%	Salary Costs

Position Title	Encumbent	Grade	Compensation	Benefits	Remarks
Salinity Control					
Sanitary Engineer	Jeffrey, Edgar A.	SSE+16	$ 3,715.00	$ 1,027.00	EOD 8/63
Geologist	Spiegel, Sidney J.	GS-12/2	4,973.76	385.06	
Clerk-Typist	Spedon, Mary G.	GS-3/8	2,333.76	159.94	
Sanitary Engineer	Meek, James W.	SE+10	2,810.00	1,026.00	Trans. 12/1/63
Stat. Clerk	Brown, Alice M.	GS-4/2	278.80	21.39	Trans. 7/23/63
		Sub-Total	14,111.32	2,619.39	
		Total	16,730.71	10.57	% of Salary Costs
Radiological Surveillance					
Chief	Wruble, Donald T.	SASE+2	880.00	388.00	EOD 11/63
Sanitary Engineer	Dawson, Herbert M.	SASE-2	1,956.00	1,139.00	
Sanitary Engineer	Esvelt, Larry		520.00	355.00	Res. 9/63
		Sub-Total	3,356.00	1,882.00	
		Total	5,238.00	3.31	% of Salary Costs
Field Station					
Sanitary Engineer	Reed, Lloyd A.	SE+6	3,030.00	1,231.00	
Sanitary Engineer	Blackman, William C.	ASE+12	1,805.00	641.00	EOD 9/63
Sanitary Engineer	Adler, Irwin B.	ASE-2	1,556.00	914.00	
Sanitary Engineer	Todd, Allen W.	ASE-2	1,556.00	1,064.00	
Eng. Technician	Korolevich, Eugene R.	GS-5/3	2,444.64	184.31	
Clerk-Stenographer	Leaman, Virginia E.	GS-4/10	1,181.04	88.46	EOD 10/13/63
		Sub-Total	11,572.68	4,122.77	
		Total	15,695.45	9.92	% of Salary Costs
Salt Lake City Laboratory					
Laboratory Direction					
Laboratory Director	Rushing, D. E.	GS-15/2	7,470.64	553.17	
Administrative Aid	Zeman, Blanche	GS-6/5	2,787.04	208.22	Prom. from GS-5 to GS-6 10/27/63
Clerk-Stenographer	Kueffner, Eileen	GS-4/1	2,090.88	161.32	
Clerk-Stenographer	Madsen, Janice C.	GS-3/1	529.92	36.24	EOD 11/18/63
		Sub-Total	12,878.48	958.95	
		Total	13,837.43	8.75	% of Salary Costs

Position Title	Encumbent	Grade	Compensation	Benefits	Remarks
Biology Laboratory					
Biologist-in-Charge	Henderson, Croswell	GS-13/5	$ 6,402.00	$ 473.76	
Biologist	Johnson, F. Allen	GS-5	1,005.60	76.08	Trans. 9/16/63
Bacteriologist	Bordner, Robert H.	GS-11/2	2,843.00	222.90	Trans. 11/3/63
		Sub-Total	10,255.60	777.74	
		Total	11,033.34	6.97	% of Salary Costs
Inorganic Chemistry Laboratory					
Supervisory Cnemist (Inorganic)	Connor, John G.	GS-13/2	5,850.24	441.25	
Chemist, Analytical	Jarrell, Raymond E.	GS-11/3	4,546.24	353.19	
Chemist, Analytical	Freking, Ronald J.	AHSO-2	1,956.00	939.00	
Phys. Science Technician	Sawtelle, Douglas C.	GS-4/2	2,164.80	166.12	Prom. to GS-5,11/24/63
		Sub-Total	14,517.28	1,949.56	
		Total	16,466.84	10.41	% of Salary Costs
Organic Chemistry Laboratory					
Supervisory Chemist (Org.)	Julian, Elmo C.	GS-13/4	6,219.84	466.92	
Chemist, Analytical	Woodward, Theodore	GS-12/2	4,973.76	390.87	
Chemist, Analytical	Kiesler, Hans	GS-9/4P	3,960.00	311.78	
		Sub-Total	15,153.60	1,169.57	
		Total	16,323.17	10.32	% of Salary Costs
Radiochemistry Laboratory					
Supervisory Chem. (Gen.RC)	Talvitie, Niilo A.	SHSO ÷ 18	4,650.00	1,240.00	
Chemist, Analytical	Garcia, William J.	GS-11/6P	4,762.56	367.25	
Chemist, Analytical	Demint, Robert J.	GS-11/3P	4,673.08	361.43	
Chemist, Analytical	Clark, Don	GS-11/1P	4,072.48	320.74	Prom. to 11/1P-11/10/63
Physical Science Aid	Sorenson, Boyd C.	GS-4/1	411.84	5.68	EOD 11/26/63
Physical Science Aid	Law, Stephen	GS-4/1	776.16	68.79	Res. cob 9/5/63
Physical Science Aid	Farmer, Richard J.	GS-4/1	300.96	23.21	Res. cob 7/25/63
		Sub-Total	19,647.08	2,387.10	
		Total	22,034.18	13.93	% of Salary Costs
		Totals	134,424.08	23,717.13	= $158,141.21 Grand Total

Step increases for C/S personnel are included in cost figures

Personnel Services, FY 1964 (3rd and 4th Quarters) 1/3/64

Region and Location Region VIII, Denver, Colorado

Program/Project No. 558
and Title Colorado River Basin Water Quality Control Project

1964 Allotment No. 4-3158

Position Title	Encumbent	Grade		Compensation	Benefits	Remarks
Project Direction						
Project Director	Sponagle, Charles E.	SEDIR + 16		$ 5,280.00	$ 1,482.00	
Deputy Proj. Director	Fitzpatrick, Joseph W.	SSE + 18		5,455.00	1,469.00	SEDIR - 2/1/64
Admin. Assistant	Gullickson, H. N.	GS-9/1		3,515.20	282.05	
Secretary	Pearson, Donna J.	GS-5/4		2,875.60	237.22	
Clerk-Stenographer	Sneddon, Evelyn K.	GS-4/3		2,284.16	180.26	
			Sub-Total	19,409.96	3,650.53	
			Total	23,060.49	11.42	% of salary costs
Salinity Damage Assessment						
Chief	Coffey, Philip J.	SSE + 18		4,980.00	1,407.00	
Sanitary Engineer	Yorke, Charles A.	SASE -2		1,956.00	1,139.00	
Sanitary Engineer	Heaney, James P.	ASE -2		1,556.00	1,065.00	
Sanitary Engineer	Yonikas, Patrick J.	ASE -2		1,556.00	915.00	
Sanitary Engineer	Vacant	GS-12		3,340.80	255.17	Pos. descr. being written Est. EOD 3/1/64
Clerk-Stenographer	Squires, Marjorie	GS-4/6		2,464.80	168.34	
			Sub-Total	15,853.60	4,949.51	
			Total	20,803.11	10.30	% of salary costs
Salinity Control						
Chief (Hydrologist)	Vacant	GS-14		3,406.00	253.05	Pos. being classified Est. EOD 4/1/64
Agricultural Engr.	Vacant	GS-13		2,931.50	220.58	Pos. descr. being written Est. EOD 4/1/64
Sanitary Engineer	Jeffrey, Edgar A.	SSE + 16		4,710.00	1,404.00	Acting Chief
Geologist	Spiegel, Sidney J.	GS-12/2		5,295.36	402.64	
Engr. Technician	Vacant	GS-7		1,941.84	160.89	Est. EOD 3/1/64
Clerk-Typist	Spedon, Mary G.	GS-3/7		2,329.60	159.55	
			Sub-Total	20,614.30	2,600.71	
			Total	23,215.01	11.50	% of salary costs

Position Title	Encumbent	Grade		Compensation	Benefits	Remarks
Radiological Surveillance						
Chief	Wruble, Donald T.	SASE + 2		$ 2,640.00	$ 1,164.00	
Sanitary Engineer	Dawson, Herbert M.	SASE - 2		1,956.00	1,139.00	
Engineering Technician	Vacant	GS-5		1,572.96	134.82	Est. EOD 3-1-64
			Sub-Total	$ 6,168.96	$ 2,437.82	
			Total	8,606.78	4.26	% of Salary Costs
Field Station						
Chief	Vacant	GS-14		$ 6,812.00	$ 506.09	Pos. Descr. being classified Est. EOD 1-1-64
Sanitary Engineer	Reed, Lloyd A.	SE + 6		3,360.00	1,280.00	Acting Chief
Sanitary Engineer	Blackman, William C.	ASE + 12		3,100.00	1,171.00	
Sanitary Engineer	Adler, Irwin B.	ASE - 2		1,921.00	928.00	
Sanitary Engineer	Todd, Allen W.	ASE - 2		1,556.00	1,065.00	
Hydrologist	Vacant	GS-9		2,352.48	188.75	Pos. being classified Est. EOD 3-1-64
Lab. Mechanic (Gen.)	Burns, John F.	GS-7		2,901.60	238.91	EOD 1-6-64
Engr. Technician	Korolevich, E. R.	GS-5/3		2,506.40	189.57	
Engr. Technician	Vacant	GS-5		2,350.40	201.47	Est. EOD 1-1-64
Clerk-Stenographer	Leaman, Virginia E.	GS-4/10		2,745.60	205.11	
			Sub-Total	$29,605.48	$ 5,973.90	
			Total	35,579.38	17.63	% of Salary Costs
Salt Lake City Laboratory						
Laboratory Direction						
Laboratory Director	Rushing, D. E.	GS-15/2		$ 8,091.20	$ 595.74	
Admin. Aid	Zeman, Blanche	GS-6/5		2,974.40	219.99	
Clerk-Stenographer	Kueffner, Eileen	GS-4/1		2,147.60	164.63	
Clerk-Stenographer	Madsen, Janice C.	GS-3/1		1,944.80	176.72	
			Sub-Total	$15,158.00	$ 1,157.08	
			Total	16,315.08	8.08	% of Salary Costs

Position Title	Encumbent	Grade	Compensation	Benefits	Remarks
Biology Laboratory					
Biologist in Charge	Henderson, Croswell	GS-13/5	$ 6,635.20	$ 494.60	
Biologist	Vacant	GS-11	3,466.80	270.76	Pos. being classified Est. EOD 2-1-64
Biologist	Johnson, Clark D.	GS-7	2,901.60	238.91	EOD 1-6-64
		Sub-Total	$13,003.60	$ 1,004.27	
		Total	14,007.87	6.94	% of Salary Costs
Inorganic Chemistry Laboratory					
Sup. Chem. (Inorganic)	Connor, John	GS-13/2	$ 6,250.40	$ 467.97	
Chemist, Analytical	Jarrell, Raymond B.	GS-11/3	4,908.80	375.88	
Chemist, Analytical	Freking, Ronald J.	AHSO - 2	1,956.00	989.00	
Phys. Science Tech.	Sawtelle, Douglas C.	GS-5/1	2,350.40	177.81	
		Sub-Total	$15,465.60	$ 2,010.66	
		Total	17,476.26	8.66	% of Salary Costs
Organic Chemistry Laboratory					
Sup. Chem. (Organic)	Julian, Elmo C.	GS-13/4	$ 6,448.00	$ 480.81	
Chemist, Analytical	Woodward, Theodore	GS-12/2	5,213.44	397.31	
Chemist, Analytical	Kiesler, Hans	GS-9/4P	4,097.60	321.53	
		Sub-Total	$15,759.04	$ 1,199.65	
		Total	16,958.69	8.40	% of Salary Costs
Radiochemistry Laboratory					
Sup. Chemist (Gen. RC)	Talvitie, Niilo A.	SHSO + 18	$ 4,980.00	$ 1,407.00	
Chemist, Analytical	Garcia, Wm. J.	GS-11/6P	4,908.80	375.88	
Chemist, Analytical	Demint, Robert J.	GS-11/3P	4,908.80	375.88	
Chemist, Analytical	Clark, Don	GS-11/1P	4,295.20	334.38	
Phys. Science Aid	Sorenson, Boyd C.	GS-4/1	2,111.20	185.92	
Phys. Science Aid	Farmer, Richard J.	GS-4/1	1,737.68	153.02	EOD 2-3-64
		Sub-Total	$22,941.68	$ 2,832.08	
		Total	25,773.76	12.77	% of Salary Costs
		Totals	$173,980.22	$27,816.21	= $201,796.43 Total

Anticipated step increases for C/S personnel have been included.

1/3/64

COLORADO RIVER BASIN WATER QUALITY CONTROL PROJECT

SUMMARY OF SALARY COSTS - FY-1964

Name of Activity	Compensation	Benefits	Tot. Sal. Costs	% Sal. Costs
Project Direction	39,643.16	7,075.31	46,718.47	12.97
Sal. Dam. Assessment	28,552.44	9,374.78	37,927.22	10.53
Salinity Control	34,725.62	5,220.10	39,945.72	11.09
Radiological Surveillance	9,524.96	4,319.82	13,844.78	3.84
Field Station	41,178.16	10,096.67	51,274.83	14.24
Laboratory Direction	28,036.48	2,116.03	30,152.51	8.37
Biology Laboratory	23,259.20	1,782.01	25,041.21	6.95
Inorganic Laboratory	29,982.88	3,960.22	33,943.10	9.43
Organic Laboratory	30,912.64	2,369.22	33,281.86	9.24
Radiochemical Laboratory	42,588.76	5,219.18	47,807.94	13.28
TOTALS	308,404.30	51,533.34	359,937.64	99.94
Project Headquarters	112,446.18	25,990.01	138,436.19	38.46
Field Station	41,178.16	10,096.67	51,274.83	14.24
Project Laboratory	154,779.96	15,446.66	170,226.62	47.29

Colorado River Basin Water Quality Control Project

Budget Analysis - FY-1964

Obj. Class		Economic Studies	Project Direction	Laboratory	Salinity Damage Assess.	Salinity Control	Field Station	Rad. Surveillance	Total
	Personal Services and Benefits								
11	Personnel Comp.		$39,643	$154,780	$28,552	$34,726	$41,178	$ 9,525	$308,404
12	Personnel Benefits		7,075	15,447	9,374	5,220	10,097	4,320	51,533
	Contractual Services and Supplies								
21	Travel & Trans. of Persons		6,000	6,000	4,000	6,000	24,000	5,000	51,000
22	Transp. of Things		1,600	3,000	1,500	600	16,000	1,800	24,500
23	Rent, Comm. & Util.		800	2,400	800	800	1,900	800	7,500
24	Printing & Reprod.		700	500	500	500	600	200	3,000
25	Other Services	50,000	550	3,950	5,000	500	9,000	8,000	77,000
26	Supplies & Materials		1,063	16,000	1,000	1,000	5,000	1,000	25,063
	Acquisition of Capital Assets								
31	Equipment		100	7,000	300	300	24,000	300	32,000
	TOTAL	50,000	57,531	209,077	51,026	49,646	131,775	30,945	580,000
	% of Total	8.62	9.91	36.04	8.79	8.55	22.71	5.33	99.95

1/8/64

BUDGET ANALYSIS

Fiscal Year 1964

	Salaries	Other	Total	% Total Budget ($580,000)
Project Headquarters				
Project Direction	$ 46,718	$ 10,813	$ 57,531	9.91
Salinity Damage Assessment	37,927	13,100	51,027	8.79
Salinity Control	39,946	9,700	49,646	8.55
Rad. Surveillance	13,845	17,100	30,945	5.33
Economic Studies		50,000	50,000	8.62
Sub-Totals	138,436	100,713	239,149	41.20
Laboratory				
Laboratory Direction	30,152	1,150	31,302	5.39
Biology	25,041	7,000	32,041	5.52
Inorganic Chemistry	33,943	6,250	40,193	6.92
Organic Chemistry	33,282	12,300	45,582	7.85
Radiochemistry	47,808	12,150	59,958	10.33
Sub-Totals	170,226	38,850	209,076	36.01
Field Station	51,275	80,500	131,775	22.71
TOTALS	$359,937	$220,063	$580,000	99.92

1/3/64

WORKING BUDGET
Request for Funds, Fiscal Year 1965

Region and Location Region VIII
Denver, Colo.

Program/Project No. 558
and Title Colorado River Basin Water Quality Control Project

1964 Allotment No. 4-3158

		1964	1965 Request	Increase or Decrease
1.	Request			
11	Personnel Compensation (Total	308,404	395,986	+ 87,582
	Compensation other than consultants			
	Consultants' fees			
12	Personnel benefits	51,533	59,024	+ 7,491
21	Travel			
	Change of station including dependents and dislocation allowance	6,500	6,000	- 500
	Car rental (all sources)	1,500	1,500	-0-
	Other	43,000	48,000	+ 5,000
22	Transportation of things			
	Change of station	7,500	6,000	- 1,500
	Other	17,000	20,000	+ 3,000
23	Rents, communications & utilities (Do not include space rental)	7,500	8,000	+ 500
24	Printing and reproduction	3,000	3,000	-0-

		1964	1965 Request	Increase or Decrease
25 Other Services				
Contracts (Itemize)				
University of New Mexico		-0-	105,000	+105,000
Department of Agriculture		50,000	50,000	-0-
Other Services		27,000	43,000	+ 16,000
Sample Collectors (Rad. Surveillance)	8,000			
Sample Collectors (Field Station)	10,000			
University of Utah (Bio. Identification)	4,000			
Laundry Service (Laboratory)	600			
Soft Water Service (Laboratory)	350			
Federal Employees Health (PHS)	250			
Stream Measurements (USGS)	10,000			
ADP Services (SEC, PHS)	8,000			
Instrument Maintenance (Laboratory)	1,000			
Tuition, fees & related services	800			
26 Supplies and materials		25,063	20,490	- 4,573

		1964	1965 Request	Increase or Decrease
31 Equipment		32,000	12,000	- 20,000
Headquarters				
Misc. small equipment	$1,000			
Replacement parts (Rad. Surveillance)	500			
Sub-Total	1,500			
Laboratory				
Proportional counter-replacement	1,500			
Replacement parts for instruments	1,000			
Platinumware, replacement & repairs	1,000			
Misc. small equipment	1,900			
Sub-Total	5,400			
Field Station				
Replacement parts for conductivity meters	3,000			
Misc. small equipment	2,100			
Sub-total	5,100			
Total	12,000			
	Total	580,000	778,000	+ 198,000

Explanation of Justification for Increase

Major increases caused by Project operating at full staff during this fiscal year and payment to University of New Mexico for continued economic activities. Work by University of New Mexico during FY-64 ($175,000) paid out of FY-63 funds.

1/6/64

WORKING BUDGET
Request for Funds, Fiscal Year 1965--Continued

Region and Location Region VIII
Denver, Colorado

Program/Project No. 558
and Title Colorado River Basin Water Quality Control Project

1964 Allotment No. 4-3158

2. Requested Apportionment

	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total
Personnel compensation & Benefits	113,753	113,753	113,752	113,752	455,010
Travel	13,875	13,875	13,875	13,875	55,500
Contracts	38,750	38,750	38,750	38,750	155,000
Other	28,123	28,123	28,122	28,122	112,490
Total	194,501	194,501	194,499	194,499	778,000

Personnel Services, FY 1965

1/3/64

Region and Location Region VIII, Denver, Colorado

Program/Project No. 558
and Title Colorado River Basin Water Quality Control Project

Position Title	Encumbent	Grade	Compensation	Benefits	Remarks
Project Direction					
Project Director	Sponagle, Charles E.	SEDIR +16	$10,785.00	$ 2,790.00	+18/2/65
Deputy Proj. Director	Fitzpatrick, J. W.	SEDIR +18	11,100.00	2,790.00	
Admin. Assistant	Gullickson, H. N.	GS-9/1	7,244.64	578.43	
Secretary	Pearson, Donna J.	GS-5/6	5,512.32	459.30	
Clerk-Stenographer	Sneddon, Evelyn K.	GS-4/3	4,656.24	366.47	
		Sub-Total	39,298.20	6,984.20	
		Total	46,282.40	10.17	% of Salary Costs
Salinity Damage Assessment					
Chief	Coffey, Philip J.	SEDIR + 18	11,200.00	2,790.00	+20/2/65
Sanitary Engineer	Yorke, Charles A.	SASE-2	3,913.00	2,277.00	
Sanitary Engineer	Heaney, James P.	SASE	5,166.00	2,309.00	+2/8/64
Sanitary Engineer	Yonikas, Patrick J.	ASE-2	3,120.00	2,128.00	
Sanitary Engineer		GS-12	10,135.04	776.09	
Clerk-Stenographer	Squires, Marjorie G.	GS-4/6	4,948.56	337.97	
Engineering Technician		GS-7/1	4,062.10	334.70	
		Sub-Total	42,544.70	10,952.76	
		Total	53,497.46	11.75%	of Salary Costs
Salinity Control					
Chief (Hydrologist)		GS-14	13,790.80	1,023.51	
Agric. Engineer		GS-13	11,875.12	892.46	
Sanitary Engineer	Jeffrey, Edgar A.	SSE	9,690.00	2,639.00	+18/1/65
Geologist	Spiegel, Sidney	GS-12/3	10,828.80	821.18	
Engineering Technician		GS-7	5,888.88	483.78	
Clerk-Typist	Spedon, Mary G.	GS-3/8	4,719.36	323.07	
		Sub-Total	56,792.96	6,183.00	
		Total	62,975.96	13.84	% of Salary Costs

Position Title	Encumbent	Grade	Compensation	Benefits	Remarks
Radiological Surveillance					
Chief	Wruble, Donald T.	SASE	$ 5,550.00	$ 2,309.00	+ 3/10/64
Sanitary Engineer	Dawson, Herbert M.	SASE	5,166.00	2,309.00	+ 2/8/64
Engineering Technician		GS-5	4,775.20	408.13	
		Sub-Total	15,491.20	5,026.13	
		Total	20,517.33	4.50	% of Salary Costs
Phoenix Field Station					
Chief		GS-14	13,903.44	1,030.83	
Sanitary Engineer	Reed, Lloyd A.	SE+8	7,020.00	2,489.00	
Sanitary Engineer	Blackman, William C.	SASE+12	7,500.00	2,309.00	
Sanitary Engineer	Adler, Irwin B.	SASE	5,370.00	2,309.00	+ 3/4/65
Sanitary Engineer	Todd, Allen W.	ASE -2	3,120.00	2,128.00	
Hydrologist		GS-9/1	7,141.92	571.75	
Lab. Mechanic (Gen.)	Burns, John F.	GS-7/1	5,918.40	485.70	
Eng. Technician	Korolevich, Eugene R.	GS-5/3	5,156.88	395.20	
Eng. Technician		GS-5	4,801.44	409.83	
Clerk-Stenographer	Leaman, Virginia E.	GS-4/10	5,512.32	411.80	
		Sub-Total	65,444.40	12,540.11	
		Total	77,984.51	17.13	% of Salary Costs
Salt Lake City Laboratory					
Laboratory Director	Rushing, D. E.	GS-15/2	16,590.64	1,218.54	
Administrative Aid	Zeman, Blanche	GS-6/5	5,971.68	441.66	
Clerk-Stenographer	Kueffner, Eileen J.	GS-4/2	4,421.20	337.62	
Clerk-Stenographer	Madsen, Janice C.	GS-3/1	3,973.76	305.27	
		Sub-Total	30,957.28	2,303.09	
		Total	33,260.37	7.30	% of Salary Costs
Biology Laboratory					
Biologist-in-Charge	Henderson, Croswell	GS-13/5	13,683.20	1,016.52	
Biologist		GS-11	8,568.72	667.76	
Biologist	Johnson, Clark D.	GS-7/1	5,918.40	485.70	
		Sub-Total	28,170.32	2,169.98	
		Total	30,340.30	6.66	% of Salary Costs

Position Title	Encumbent	Grade	Compensation	Benefits	Remarks
Inorganic Chemistry Laboratory					
Sup. Chemist (Inorg.)	.Connor, John G.	GS-13/2	$12,744.96	$ 952.26	
Chemist, Analytical	Jarrell, Raymond E.	GS-11/6	10,073.76	772.10	
Chemist, Analytical	Freking, Ronald J.	SAHSO	4,482.00	2,298.00	+2/3/65
Phys. Science Tech.	Sawtelle, Douglas C.	GS-5/1	4,816.16	363.29	
Chemist, Analytical		GS-9/1	4,921.00	395.08	
		Sub-Total	37,037.88	4,780.73	
		Total	41,818.61	9.19	% of Salary Costs
Organic Chemistry Laboratory					
Sup. Chem. (Organic)	Julian, Elmo C.	GS-13/4	13,164.48	982.80	
Chemist, Analytical	Woodward, Theodore	GS-12/2	10,745.60	812.51	
Chemist, Analytical	Kiesler, Hans	GS-9/4P	8,321.76	651.70	
		Sub-Total	32,231.84	2,447.01	
		Total	34,678.85	7.62	% of Salary Costs
Radiochemistry Laboratory					
Sup. Chem. (Gen. RC)	Talvitie, Niilo A.	SHSO	10,210.00	2,639.00	+20/9/64
Chemist, Analytical	Garcia, William J.	GS-11/P6	10,147.68	776.91	
Chemist, Analytical	Demint, Robert J.	GS-11/3P	9,763.84	748.70	
Chemist, Analytical	Clark, Don	GS-11/1P	9,200.08	712.05	
Phys. Science Aid	Sorenson, Boyd C.	GS-4/1	4,323.76	378.78	
Phys. Science Aid	Farmer, Richard J.	GS-4/1	4,371.92	381.91	
		Sub-Total	48,017.28	5,637.35	
		Total	53,654.63	11.79	% of Salary Costs
			$395,986.06	$59,024.36	= $455,010.42

Anticipated promotions for C/O and step increases for C/S personnel have been included.

1/3/64

COLORADO RIVER BASIN WATER QUALITY CONTROL PROJECT

SUMMARY OF SALARY COSTS - FY-1965

Name of Activity	Compensation	Benefits	Tot. Sal. Costs	% Sal. Costs
Project Direction	39,298.20	6,984.20	46,282.40	10.17
Sal. Dam. Assessment	42,544.70	10,952.76	53,497.46	11.75
Salinity Control	56,792.96	6,183.00	62,975.96	13.84
Radiological Surveillance	15,491.20	5,026.13	20,517.33	4.50
Field Station	65,444.40	12,540.11	77,984.51	17.13
Laboratory Direction	30,957.28	2,303.09	33,260.37	7.30
Biology Laboratory	28,170.32	2,169.98	30,340.30	6.66
Inorganic Laboratory	37,037.88	4,780.73	41,818.61	9.19
Organic Laboratory	32,231.84	2,447.01	34,678.85	7.62
Radiochemical Laboratory	48,017.28	5,637.35	53,654.63	11.79
TOTALS	395,986.06	59,024.36	455,010.42	99.95
Project Headquarters	154,127.06	29,146.09	183,273.15	40.27
Field Station	65,444.40	12,540.11	77,984.51	17.13
Project Laboratory	176,414.60	17,338.16	193,752.76	42.58

Colorado River Basin Water Quality Control Project

Budget Analysis - FY-1965

Obj. Class		Economic Studies	Project Direction	Laboratory	Salinity Damage Assess.	Salinity Control	Field Station	Rad. Surveillance	Total
	Personal Services and Benefits								
11	Personnel Comp.		$39,298	$176,415	$42,545	$56,793	$65,444	$15,491	$395,986
12	Personnel Benefits		6,984	17,338	10,953	6,183	12,540	5,026	59,024
	Contractual Services and Supplies								
21	Travel & Trans. of Persons		5,000	6,000	4,000	6,000	29,500	5,000	55,500
22	Trans. of Things		1,600	3,000	1,500	600	17,500	1,800	26,000
23	Rent, Comm. & Util.		900	2,400	900	900	2,000	900	8,000
24	Printing & Reprod.		700	500	500	500	600	200	3,000
25	Other Services	$155,000	500	6,950	8,000	500	19,050	8,000	198,000
26	Supplies & Materials		463	14,427	300	300	4,000	1,000	20,490
	Acquisition of Capital Assets								
31	Equipment			5,400	500	500	5,100	500	12,000
	TOTAL	$155,000	55,445	232,430	69,198	72,276	155,734	37,917	778,000
	% of Total	19.92	7.12	29.87	8.89	9.28	20.01	4.87	99.96

1/8/64

BUDGET ANALYSIS

Fiscal Year 1965

	Salaries	Other	Total	% Total Budget ($778,000)
Project Headquarters				
Project Direction	$ 46,282	$ 9,163	$ 55,445	7.12
Salinity Damage Assessment	53,498	15,700	69,198	8.89
Salinity Control	62,976	9,300	72,276	9.28
Rad. Surveillance	20,517	17,400	37,917	4.87
Economic Studies		155,000	155,000	19.92
Sub-Totals	183,273	206,563	389,836	50.08
Laboratory				
Laboratory Direction	33,260	1,100	34,360	4.41
Biology	30,341	12,000	42,341	5.44
Inorganic Chemistry	41,818	7,800	49,618	6.37
Organic Chemistry	34,679	6,827	41,506	5.33
Radiochemistry	53,655	10,950	64,605	8.30
Sub-Totals	193,753	38,677	232,430	29.85
Field Station	77,984	77,750	155,734	20.01
TOTALS	$455,010	$322,990	$778,000	99.94

TARGET WORKING BUDGET 1/6/64

Fiscal Year 1966

Region and Location Region VIII
Denver, Colorado

Program/Project No. 558
and Title Colorado River Basin Water Quality Control Project

1964 Allotment No. 4-3158

		1965 (Estimate)	1966 (Estimate)	Increase or Decrease
1.	Request			
11	Personnel Compensation(Total)	395,986	395,986	-0-
	Compensation other than consultants			
	Consultants' fees			
12	Personnel benefits	59,024	59,024	-0-
21	Travel			
	Change of station including dependents and dislocation allowance	6,000	4,000	-2,000
	Car rental (all sources)	1,500	1,500	-0-
	Other	48,000	35,000	-13,000
22	Transportation of things			
	Change of station	6,000	4,000	-2,000
	Other	20,000	15,000	-5,000
23	Rents, communications & utilities (Do not include space rental)	8,000	6,000	-2,000
24	Printing and reproduction	3,000	2,500	-500
25	Other services			
	Contracts (Itemize)			
	University of New Mexico	105,000	25,000	-80,000
	Dept. of Agriculture	50,000		-50,000
	Other	43,000	22,000	-21,000

1/6/64

TARGET WORKING BUDGET

Fiscal Year 1966--Continued

		1965 (Estimate)	1966 (Estimate)	Increase or Decrease
26	Supplies and materials	$20,490	$15,490	- $5,000
31	Equipment (Itemize and justify. Use separate sheet if necessary)	12,000	8,000	- 4,000
	Total	778,000	593,500	-184,500

1/6/64

LONG RANGE BUDGET ESTIMATES

1967		1968	
Positions	Amount	Positions	Amount
52	$554,500	10	$ 130,000

Note: 1968 projection taken from Highlight Statement Comprehensive Program (undated) transmitted with Mr. Krause's memo of November 6, 1963.

1/8/64

DIVISION OF WATER SUPPLY AND POLLUTION CONTROL

Summary of Changes

Project Colorado River Basin Water Quality Control Project   Date Prepared January 7, 1964

	Pos.	Amount
1964 Estimated Working Budget	50	$580,000
A. Built-in changes		
1. Decreases		
(a) Nonrecurring equipment		- 32,000
(b) One less day of pay		- 1,170
(c) Travel - Change of station		- 500
(d) Transportation of things - Change of station		- 1,500
(e) Supplies and materials		- 4,573
2. Increases		
*(a) Annualization of 12 new positions		+ 66,169
(b) Increased pay costs:		
(1) Civilians		+ 6,081
(2) Commissioned Officers		+ 14,280
B. New Program Items		
1. Equipment		+ 12,000
2. Travel - Other		+ 5,000
3. Transportation of things - Other		+ 3,000
4. Rents, communications and utilities		+ 500
5. Contracts - University of New Mexico		+105,000
6. Other services		+ 16,000
7. Two new positions	2	+ 9,713
Total		+198,000
1965 Estimated Working Budget	52	$778,000

NOTE: Increased pay costs for civilians and commissioned officers not only reflect effects of pay bills, but also anticipated promotions and step increases.

*(Positions to be filled 3rd and 4th Quarters FY 1964) (See Personnel Services, 3rd and 4th Quarters, FY 1964)

DIVISION OF WATER SUPPLY AND POLLUTION CONTROL

Summary of Changes

Project Colorado River Basin Water Quality Control Project

Date Prepared January 7, 1964

	Pos.	Amount
1965 Estimated Working Budget	52	$ 778,000
A. "Built-in" changes		
1. Decreases		
(a) Nonrecurring equipment		-12,000
(b) Travel - Change of station		- 2,000
Other		-13,000
(c) Transportation of Things - Change of station		- 2,000
Other		- 5,000
(d) Rent, communications, and utilities		- 2,000
(e) Printing and reproduction		- 500
(f) Economic contracts		
University of New Mexico		-80,000
Department of Agriculture		-50,000
(g) Other services		-21,000
(h) Supplies and materials		- 5,000
2. Increases		
None		
B. New Program Items		
1. Equipment		8,000
Total		-184,500
1966 Estimated Working Budget	52	$593,500

EXTERNAL EXPENDITURES
(thousands of dollars)

Project: Colorado River Basin Water Quality Control Project
FY : 1964
Date : 1/7/64

Amount	Method*	Recipient	Description of Work
$50,000	R	Department of Agriculture	Economic projections
8,000	P	Private Individuals	Radiological sample collections
4,000	P	Private Individuals	Salinity sample collections
5,000	R	U. S. Geological Survey	Stream measurements
5,000	R	RATSEC, PHS	Automatic data processing
2,000	P	University of Utah	Biological identification
1,000	P	Various Firms	Instrument maintenance
600	P	Laundry	Laundry service
350	P	Firm	Soft water service
825	P	Miscellaneous	Tuition, fees, and related services
225	P	Health Unit, PHS	Federal Employee Health
$77,000	Total		

* C - Contract
R - Reimbursement to other Federal Agency
P - Purchase order
O - Other, specify

1/7/64

EXTERNAL EXPENDITURES
(thousands of dollars)

Project: Colorado River Basin Water Quality Control Project
FY : 1965
Date : 1/7/64

Amount	Method*	Recipient	Description of Work
$105,000	C	University of New Mexico	Economic projections
50,000	R	Department of Agriculture	Economic projections
8,000	P	Private individuals	Radiological sample collections
10,000	P	Private individuals	Salinity sample collections
4,000	P	University of Utah	Biological identification
10,000	R	U. S. Geological Survey	Stream measurements
8,000	R	RATSEC, PHS	Automatic data processing
1,000	P	Various firms	Instrument maintenance
600	P	Laundry	Laundry service
350	P	Firm	Soft water service
250	R	Health Unit, PHS	Federal Employee Health
800	P	Miscellaneous	Tuition, fees, and related services
$198,000	Total		

*C - Contract
R - Reimbursement to other Federal Agency
P - Purchase order
O - Other, specify

1/10/64

BUDGET BY ACTIVITIES
(thousands of dollars)

Project: Colorado River Basin Water Quality Control Project
FY : 1964-1965
Date : 1-10-64

Activity	1964	1965
Headquarters and administration:		
Headquarters	$57,531	$55,445
Laboratory	31,302	34,360
Social sciences:		
Projections & benefit analysis	50,000	155,000
Physical sciences:		
Inventory	20,000	20,000
Field instrumentation	23,200	3,500
Measurement and sampling	119,520	170,151
Laboratory equipment	7,936	5,400
Laboratory services	169,838	192,670
Machine data processing	5,000	8,000
Data analysis & evaluation	72,673	100,474
Reports:		
Preparation	20,000	30,000
Printing	3,000	3,000
	$580,000	$778,000

SPACE

Project: Colorado River Basin Water Quality Control Project
FY : 1964
Date : 1/2/64

Location	Use	Area (sq. ft.)	Cost
Denver Federal Center Building 22 Denver 25, Colorado	Project Headquarters	3450	None
1750 South Redwood Road Salt Lake City, Utah	Project Laboratory	8350	None
106 East Roosevelt Street Phoenix, Arizona	Project Field Station	3000	See Note

Note: Space acquired August 1963 for approximately $790/month by GSA. Space paid for by the Division, Washington, D. C.

I COMMUNICATION..

II PROJECT DESCRIPTION & MAP............................

III CONSULTANTS AND COMMITTEES..........................

IV ACTIVITIES & ACCOMPLISHMENTS, FY 1964............

V PLANS AND SCHEDULE, FY 1965..........................

VI PLANS, FY 1966..

VII ORGANIZATION AND MANAGEMENT.........................

VIII OTHER MATERIALS (Appendices).......................

APPENDIX [illegible]

COLORADO RIVER BASIN WATER QUALITY CONTROL PROJECT

Region VIII

Technical Design
December 30, 1963

This document has been prepared to illustrate the approach and objectives of the Project's salinity study in a coordinated and comprehensive manner, and in as much detail as is now possible. It will serve as a guide to the several portions of the study and will acquaint other interested parties with the total scope of this program. Comments or suggestions are welcomed.

It is anticipated that this paper will be revised at appropriate times as the study progresses and experience permits the definition of certain elements in more detail.

12/30/63

TECHNICAL DESIGN

SALINITY STUDIES

General Objectives

A. To assess the nature and magnitude of the salinity problem in the main stem of the Colorado River and its tributaries.

B. To investigate and evaluate feasible methods of controlling and minimizing salinity concentrations and loads in the River, and

C. To evaluate the net basinwide economic benefits associated with various degrees of salinity control.

General Technical Approach

The following broad steps represent an orderly and systematic technical approach designed to meet the foregoing general objectives. This approach is applicable either to the entire Basin or to individual sub-basins. It will be applied first in the Lower Basin, to the Lower Main Stem sub-basin, and then to the Gila and Little Colorado sub-basins. Upon completion of work in the Lower Basin the program will be carried forward in the Upper Basin, consisting of the Upper Main Stem, Green, and San Juan sub-basins (see attached map).

It should be noted that the steps involved are presented in systematic sequence. During implementation of the program, however, it is expected that all of these activities will be underway concurrently for different parts of the basin.

I. Determination of existing salinity conditions

The specific purpose here is to explain the observed river salinity concentrations and loads in terms of the specific salinity sources and/or other factors responsible for causing river salinity loadings and concentrations to change.

A. Observation of present river salinity concentrations and loadings.

(1) River Sampling Network

(a) Permanent sampling stations -- at key locations, 1 year or longer record, use of conductivity meters, calibration (cond. vs. TDS), specific constituent analyses.

(b) Temporary sampling stations. One week to one month record at less important locations. These may be sampled individually or as groups, depending on needs, and sampling may be repeated; use of conductivity meters and specific constituent analyses. Operation of these stations to be staggered rather than concurrent. There may be, say, 5 operating concurrently, depending on capability of field crew and laboratory.

(c) Utilize presently existing stations where data is being developed by other Federal or state agencies and is suitable for incorporation into Project [illegible] (USGS water quality stations, for example).

(2) Flow gaging - Use existing USGS and other permanent recording gages as possible. Will involve having USGS set up additional recording gages at permanent sampling stations as required, and recording or staff gages at temporary sampling stations as necessary.

(3) Precipitation - Use existing weather stations (Weather Bureau, airports, other) as possible. May involve establishment of additional gages in areas of more intensive field study. Water from this source may constitute a significant portion of the water budget for agricultural use (moreso in Upper Basin than in Lower Basin).

(4) Times of Flow - will be required for specific river reaches where necessary to correlate downstream conditions with upstream discharges; for instance, between intermittent or variable salinity load sources and permanent sampling stations. The principal method will utilize dye tracers and continuous recording fluorimeters. It is anticipated that need for times of flow will be limited rather than extensive.

B. Evaluation of existing salinity load sources.

This will involve sampling, conductivity measurements, flow gaging, and times of flow to an extent dependent on the type and relative importance of the source.

(1) Natural Sources. Relatively large surface flows (Paradox Valley, large springs) will be sampled and continuously gaged for relatively long periods (1 month or more) conductivities will continuously recorded and specific constituent analyses performed.

Relatively minor sources (such as small springs or seeps) will be sampled occasionally on a grab basis and roughly gaged at the same time; initial evaluation of ground water inflow sources will be based upon observed differences between stream sampling stations.

(2) Municipal and industrial sources.

All pertinent information concerning municipal and industrial sources will be obtained. This will include for municipalities; location, population, source of water, amount used, sewage treatment, point of discharge, sewage flows. For industries; location, type product, output, source of water, water uses, amount used, waste treatment, waste discharge, and volume. For small communities, say less than 500 population and for smaller industries, grab samples for specific constituent analyses on occasion and use of conductivity meters. For larger communities and industries, several days or longer continuous sampling and conductivity recording. Analyses of water supply in order to estimate TDS load added by use. Analyses of municipal sewage and industrial wastes for TDS, including specific ions such as chlorides, sulfates, etc. Gage waste discharges for small communities and industries at time of sample collection. For larger communities and industries, gage flow frequently or continuously during sampling period (possible use of water level recorders).

(3) Agriculture and irrigation return flows.

All irrigation districts and significant individual farms will be identified. Information will be developed concerning acres irrigated, crops grown, irrigation period, fertilizer use, methods of irrigation, source of water (in some cases both ground and surface water is used), quantities of water used, types of soils, water returns to stream (surface flows through return drains, subsurface flows through tile drainage system, indirect returns via general ground-water table conditions).

For larger irrigated areas and irrigation districts, continuous sampling and flow gaging for relatively long periods (1 month or more). Use conductivity meters, specific constituent analyses for input water (whether surface, ground, or a combination of both), and all surface and subsurface return flows which can be identified. (Some subsurface return flows will not be specifically identifiable but will consist of seepage returns to the river over a relatively large area. Attempt to estimate the magnitude and salt contribution of this type of return water from data developed at river stations above and below the irrigated area, taken in conjunction with the data developed for all identifiable surface and subsurface returns. If there are significant unexplained contributions further investigations will be undertaken). Continuous flow records for all flows sampled.

For smaller irrigated areas similar information will be developed. Here studies will involve shorter time periods (say 1 week to 1 month, perhaps repeated twice or more). In some cases districts may be carrying forward a program of development of data which may possibly be incorporated into our study.

Estimate seepage losses in conveyance channels. May require additional flow gaging within water supply system. Such measurements will give combined losses due to seepage and evaporation and suitable adjustments must be made (see following section C (1). Investigate effects on ground-water tables (increased returns of ground-water seepage to river).

Much of the above information will be obtained from appropriate sources where it is routinely developed.

C. Evaluation of salinity concentration influences.

(1) Surface Evaporation

Estimate water losses from system due to evaporation from water surfaces. These will include impoundments, surface of the flowing stream, irrigation conveyance structures, and water spread on land for irrigation. Investigate studies which have been made to determine evaporation rates and use results as possible. Additional determinations of evaporation rates may be required in specific study areas.

(2) Consumptive losses of water.

Municipal and industrial - Quantity of water intake less quantity returned to stream. When ground-water sources are involved, will increase stream flow below point of discharge.

Agricultural - Refers to evapotranspiration losses associated with crop production. (Evaporation and seepage losses have been considered above). Estimate from studies made in specific areas and/or by use of available formulas. Will involve investigation of alternate methods of estimating and selection of most appropriate method.

(3) Trans-basin water diversions (out-of-basin).

Determine volumes of water leaving basin and amount of salts. Involves flow gaging, conductivity measurements, specific oonstituent analyses.

(4) Evapotranspiration losses -- phreatophytes and all evapotranspiration losses other than specifically mentioned above under agriculture. Determine where concentrated intrusions of phreatophytes occur along river and estimate water losses involved. Studies made by other Federal agencies (USGS, Bureau of Reclamation, Corps of Engineers) will provide useful information.

D. Evaluation of other factors.

(1) Precipitation of salts and ionic base exchange in impoundments or in the flowing stream. Effects on reducing salinity loadings and/or concentrations. Redissolution of precipitated salts and its effects. Little is known with respect to this phenomenon at present by the Project staff. It will have to be explored to determine its significance.

(2) Diversions into the basin. Gage flows, conductivity readings, specific constituent analyses. At the present time only a very minor amount of water and salts are entering the basin in this manner.

E. Calculate other statistically expected flows under present conditions of development in the basin--flow frequency analyses, including various combinations of flows, main stem and tributary. Estimate range of salinity concentration expected.

As the foregoing activities proceed and the indicated data is developed, the information will be used to:

(a) Picture the present conditions in the basin with respect to salinity loadings and concentration in the main stem of the Colorado River and in the tributaries. This will involve balancing the salt loads existing in the surface waters going downstream and explaining the changes in salt concentrations in terms of addition and removal of salts and losses of water to the system

(b) Identify those points on the stream where significant increases in salinity loadings and/or concentrations are occurring and identify the specific sources responsible for such increases.

(c) Determine the relative significance of each individual source in contributing to the increased salinity loadings and/or concentrations observed in the stream. By this is meant the relative significance of two irrigation districts, for example, or the relative significance of an industry vs. a municipality or natural source.

(d) Determine the relative significance of each type of source in contributing to the increased salinity loadings and/or concentrations observed in the stream. In this case the sources would be classified under such headings as: municipal, industrial, agricultural, natural, etc.

II. Future Growth and Development

The specific purpose here is to estimate the future magnitude and pattern of growth and development of population, industry, agriculture, recreation, etc., in the basin, and consider the possible future construction of additional water resource development structures; then to predict future salinity loads and concentrations on the basis of anticipated growth patterns and available water; and finally to estimate salinity damages associated with these changes.

The predictions of future growth and development are being carried out under the contract with the University of New Mexico and a memorandum of agreement with the U. S. Department of Agriculture. These predictions will be on a local (county) and on a sub-basin basis. Anticipated water resource developments and their effects on river hydrology will be obtained from other Federal agencies and will be incorporated into the predictions of economic growth and development. The predictions of future salinity concentrations and loads, and the estimates of associated salinity damages, will be provided by the Project staff.

A. Obtain information from other Federal and State sources as to planned future water resource developments and alternate developments, including location, estimated completion dates, effects on river hydrology, and other related information.

    (1) Estimate anticipated dependable river flows in stipulated future years (i.e., 1980, 2010 for example). (Adjust flow frequencies determined earlier under Section I, E). (Project staff).

B. Develop anticipated sub-basin economic growth pattern assuming adequate quantity and quality of water everywhere. (By contractor).

    (1) Determine quantity of water required for unrestricted growth pattern. (Project staff and contractor).

C. Provide contractor with estimated future flows developed in A(1) above. Examine growth pattern from B in terms of actual quantities of water expected to be available. (Contractor and Project staff).

D. If the water quantities required by the unconstrained growth pattern exceed the quantities expected to be available, readjust growth pattern as necessary to fit within available water quantity. The resulting adjusted economic growth pattern will be the maximum growth consistent with available expected quantities of water. Its magnitude will be equal to or less than the unrestrained growth pattern referred to in B above. It will most probably include possible alternate growth patterns. (For example, sufficient water may be available for an agricultural or an industrial development, but not both). (By contractor).

E. Estimate and predict salinity loads and concentrations in stipulated years (i.e., 1980, 2010, for example) associated with expected available flows and alternate growth patterns from D above. (Project staff)

(1) This includes estimates for salinity concentrations in the water delivered to each user.

III. Evaluation of damages to water uses associated with various salinity concentrations (Salinity Damage Assessment).

The specific purpose here is to determine the types of damage or impairment associated with each legitimate water use, and to evaluate the degree of damage associated with existing and future estimated salinity levels. This degree of damage involves not only such obvious items as additional costs of water treatment to the user, but also such secondary effects as his increased water quantity needs, and costs to the downstream user associated with resulting further degradation of quality.

It should be noted that the present damages involved are relative to possible decreases of present salinity concentrations. Thus, these damages may be looked upon as that fraction of present water costs that would not have occurred if salinity concentrations had not reached present levels. These are also, therefore, the reduced water costs that could result if present salinity concentrations were to be reduced, and the difference between the costs of reducing in-stream salinity and the above-mentioned damages will represent a net benefit to the water users.

Future increases in damage are relative to expected increases in present salinity concentrations. Thus these damages may be looked on as that fraction of future water costs which could be prevented from occurring if salinity concentrations were to remain at present levels. These are also, therefore, the savings in cost of water that could result if present salinity concentrations could be maintained, and the difference between the costs of maintaining these concentrations under future conditions and the above-mentioned increases in damages will represent a net benefit to the water users.

A. Types of damages to water users

(1) Municipal Use

(a) Water over 500 ppm is undesirable, and over 1000 ppm unacceptable for municipal water supply, according to U. S. Public Health Service drinking water standards. This may require a common carrier to obtain its water elesewhere when this standard is exceeded.

(b) Increased consumption of soap and detergents, and formation of scum and curds.

(c) Yellow staining and decreased life of fabrics.

(d) Formation of scale in water heaters and plumbing fixtures generally, reducing their length of service.

(e) Increased corrosion of water lines and fixtures; resulting in shorter life and more frequent replacement. Includes need for corrosion-resistant materials in water treatment plants at increased cost.

(f) Cost of using bottled water.

(g) Cost of water softening (municipal plant or home user).

(h) Damages to ornamental shrubs and other plants.

(i) Need to develop an alternative source of water supply as salinity increases in present source.

(j) Possible physiological effects due to the concentrations of certain specific constituents, such as sodium and nitrates.

(2) Industrial Use

(a) Formation of scale in cooling-water systems, boiler tubes, water heaters, and water supply and distribution systems generally, especially those conveying hot water, with consequent higher service costs and shorter service life.

(b) Carry-over of saline water into the steam in boilers, with resulting lower efficiency of operation.

(c) Weakening of concrete (water containing over 400 ppm of sulfates in unacceptable for use in making concrete which is to be pre-stressed).

(d) Excessive hardness and mineral ion content render water unsatisfactory for many industrial process uses, including laundering, dyeing and textile manufacture, brewing, carbonated beverages, candy-making, food processing, and photography. The industrial requirements are in some cases more exacting than the standards for drinking water. (For example, toughening of vegetables cooked with highly mineralized water (commercial vegetable canners generally avoid process waters over 200 ppm hardness, or soften below that figure).

(3) Agriculture (Irrigation of Crops)

(a) The duty of water, i.e., the amount applied per unit area for equivalent results, rises in proportion to salinity of the applied water, owing to the greater amount of poor quality water needed to leach salts out of the soil in the plant root-zone. Hence irrigating with water of poor mineral quality is more expensive than with good water. The effect is compounded by:

   (i) Greater loss of applied fertilizers leached by the higher amount of water needed.

   (ii) Higher labor costs caused by the need for more frequent irrigations.

   (iii) Raised cost of under-drainage of land irrigated with poor quality water, since the system must be designed for greater volumes of flow. In some cases no under-drainage would be necessary with irrigation water of high quality, so that the entire cost of drainage is attributable to poor water.

(b) Saline irrigation waters are harmful to many types of crops, especially those classified as salt-sensitive, such as citrus and deciduous fruits, certain garden vegetables, nursery plants and shrubs, etc. Depending on the concentration of mineral salts, yield of crops may be reduced or the plants actually destroyed.

(c) Where a fixed amount of water is available to the irrigator it may be necessary to reduce the crop acreage as salinity increases in the applied water.

(4) Decreased possibility for economic development due to increased demand for irrigation water as salinity increases, thus result-in less water being available for other uses.

B. Evaluation of damages - present conditions

(1) Determine cost of water to the different types of users with changing salinity. This cost will be different for each type of use involved and will include consideration of the items in "A" above. Show as a function of salinity.

In some cases salinity per se will not constitute the only significant parameter. Individual constituents such as boron, sodium, chloride, etc. must be considered in addition to the TDS concentrations.

(2) Summate costs to various users at one or more salinity concentrations lower than those presently existing. This will give total water costs (say for a sub-basin) to the users.

(3) Summate costs to various users at existing salinity concentrations. The difference between this cost and those developed in step (2) above will represent the damages involved relative to the lower concentrations, or viewed in another way, the benefits to be expected if stream salinity concentrations could be reduced.

(4) Determine present damages to water users by type, i.e., municipal, industrial, agricultural, etc., under observed

salinity concentrations and flows determined during field studies of I.

(5) Compute other statistically expected flows under present conditions of development in the basin by a flow frequency analysis, including various combinations of flows, main stem and tributary. Determine range of salinity concentrations and expected damages to water users under present conditions.

C. Evaluation of damages - future conditions

Growth patterns as furnished by the economic contractor (including alternates), and estimated salinity loadings and concentrations associated with possible future conditions will serve as the basic information for this evaluation (steps indicated under Section II above, items D and E). An analysis similar to that indicated in B above will be made to show the extent of damages associated with these expected future conditions.

IV. Feasible Salinity Control Measures

The specific purpose here is to investigate and evaluate technically feasible salinity control measures which will reduce or minimize salinity loadings and concentrations in the river system. This will also include estimates of the costs associated with such control measures in order to compare costs of salinity reduction with benefits to be expected from improving water quality.

A. Control methods to be considered for purposes of technical study.

(1) Control natural brines - reduce flow, stop flow or control flow.

(2) Control salt load - highly saline tributaries, other discharges. (Investigate effects of phasing discharges with periods of high river flows.)

(3) Reduce evaporation - excess field water, reservoirs, irrigation canals.

(4) Control ground water hydraulics - reduce seepage losses in irrigation canals, with lowering of ground water table. Reduce application of excess water to irrigated areas.

(5) Limit water uses - make water unavailable for certain use.

(6) Change water use - from significant source of salinity to other type of use.

(7) Regulate streamflow.

B. Technical feasibility studies

(1) Investigate the technical feasibility of application of one or more of the above control methods to the sources increasing salt loadings and/or concentrations. The character of the source will affect the type of control methods to be considered and must be fully understood before the possibilities of control can be evaluated.

(2) Determine the attainable degree of improvement of water quality (as reflected by decreased salt loadings and/or concentrations) which would be possible with control methods. In some cases alternate methods of control may be applicable to the same source.

  (a) Water quality improvement in immediate area downstream of source.

  (b) Routing of water quality improvements throughout system and effects at most southerly part of river.

(3) Where alternate control methods may be considered, determine comparative technical feasibility.

C. Cost estimates and economics of control

(1) Estimate cost of various control methods determined to be technically feasible. Where methods involve sealing of canals to reduce seepage, construction of flow regulation structures, phreatophyte elimination, and the like, secure assistance of appropriate construction agency (Corps of Engineers, Bureau of Reclamation) in developing reasonable estimates of costs.

(2) Compare alternate methods of control on basis of unit salinity improvement per unit of cost.

(3) Determine minimum investment for maximum water quality improvement.

V. Water Quality with Control Methods

The specific purpose here is to determine improvements in present and future water quality with feasible control methods in operation. Initially these improvements can be evaluated only in the immediate geographical area under study. For example, the Project is beginning these investigations in the Lower Main Stem Sub-Basin (see attached map). As the feasibility of control methods for sources in this sub-basin is determined, the improvements in water quality in this part of the basin with these control methods in operation can be estimated. However, the further improvements in water quality that may be possible in the Lower Main Stem Sub-Basin due to institution of feasible control measures in the upstream sub-basins (such as, for example, the Green River Sub-Basin) cannot be determined until similar investigations are completed there. Consequently, the limitations imposed on arriving at a complete evaluation of attainable improvements in water quality in some sub-basins are substantial and must be recognized.

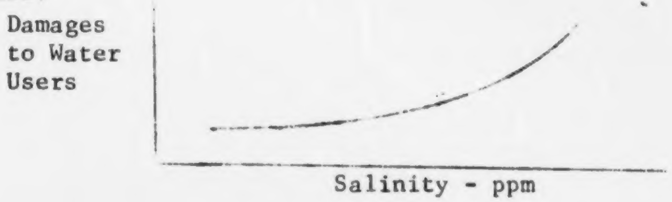
A. Modify the picture of present salinity loadings and concentrations developed in step I to reflect the changes which would be expected with control measures in effect.

B. Do the same for the picture of future expected conditions as developed in step II, including the alternate development patterns which may occur.

VI. Economic Balance

The specific purpose here is to compare the costs of obtaining reduced or minimized instream salinity concentrations with the benefits to the water users associated with these reductions, both under present conditions (section I), and future expected conditions (section II), so as to determine the net benefits resulting from implementation of the control measures which might feasibly be put into effect.

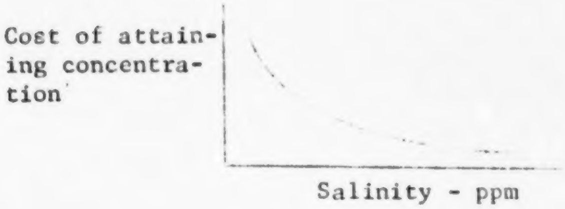
A. For a sub-basin, plot a function showing damages to water users as concentration of salinity (total dissolved solids). By "damages" is meant the increased cost to the water users as determined under Section III of this outline, as salinity concentrations vary. The shape of this curve is not at present known; however, it seems reasonable to expect that as salinity concentrations increase, the damages will also increase. For illustrative purposes, therefore, say that the following type of curve is obtained.



A series of such curves will be developed for different conditions, that is, one curve may be plotted for present conditions, another for expected conditions, say in 1980, a third for expected conditions in 2010.

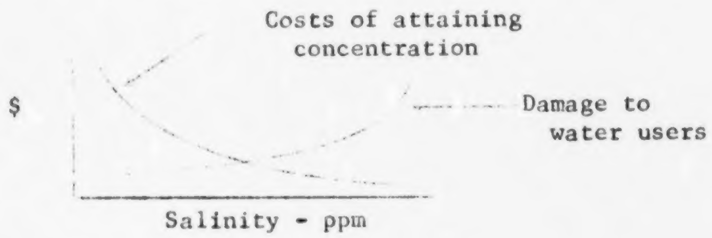
Depending on the sub-basin and water uses involved, it may be desirable to develop the damage information and curves at several key locations in a sub-basin.

B. Plot a function showing cost of reaching various instream salinity concentrations by means of conrol measures vs. salinity concentrations. Again, the shape of this function is not now known; however, it is reasonable to expect that these costs will increase as salinity is reduced from higher to lower concentrations. For illustrative purposes therefore, say that the following curve is obtained from section IV.



Here again, a series of curves for different years, and at key locations will be developed, as for the damage curves in "A" above.

C. Compare these curves to show net benefits.



(1) At salinity concentrations higher than that existing at the point of intersection of these curves the damages to water users exceeds the costs of reducing instream salinity concentrations. Consequently, there will be a net economic benefit in reducing the salinity concentrations by initiation of control methods, if present or predicted future concentrations exceed this optimum value.

(2) At salinity concentrations lower than existing at the point of intersection of these curves, the costs of reducing instream salinity exceed the damages to the water users, so that no net economic benefits will be obtained by reducing instream salinity below the point of intersection, if present or predicted future concentrations exceed this optimum value.

(3) The salinity concentration indicated at the point of intersection therefore is a criterion of stream salinity concentration which would provide the maximum net economic benefit to the basin in terms of costs.

APPENDIX B

PHOENIX FIELD STATION PROGRAM
LOWER MAIN STEM SUB-BASIN

Fiscal Year 1964 - 1965

Classification, Description and Scheduling of Tasks

(1) Organization and Planning

This activity comprises recruitment and training of staff, acquisition of equipment and establishment of the Phoenix Field Station. Also included under this activity are preliminary reconnaissance of the area survey within the lower main-stem sub-basin, program planning, and budget preparation.

The following specific comments are pertinent:

(a) The GS-7 Laboratory Mechanic should be on duty by early January 1964. The GS-9 Hydrologist will be on duty by February 1964. The Civil Service Register has been requested for the position of the GS-5 Engineering Technician and the vacancy will be filled as soon as possible.

(b) Additional conductivity recorders on order since June 1963 may be received by late January 1964.

(2) Interagency Cooperation

Interested agencies, Federal, State and local, have been contacted to inform them of our intended activity and to enlist their cooperation. The Bureau of Indian Affairs, the Geological Survey, the International Boundary and Water Commission and the Bureau of Reclamation have been contacted by the Field Station staff. Inquiries were made regarding the parallel efforts of other agencies. Arrangements have been made to obtain on short schedule, relevant data on water quality and stream flows previously or presently being acquired by other field agencies. This activity includes conferences with field personnel of other Government agencies and a synoptic water quality field survey of the Lower Colorado, in cooperation with the U.S. Geological Survey, in January 1964.

(3) River Quality Survey

This activity will endeavor to show the nature, magnitude and distribution of saline pollution in natural streams of the area. Water Quality sampling stations have been established at 15 locations in the reaches of the Colorado below Hoover Dam, and sampling was begun October 20, 1963. Supplementary data are being obtained on short schedule for seven additional locations presently under surveillance by the Geological Survey, the International Boundary and Water Commission, and the Metropolitan Water District of Southern California. Samples are being collected at weekly or bi-weekly intervals as described in attachment A, and sent to the Salt Lake City laboratory of the Project for analysis. The specific properties and constituents which are being examined are shown in full detail in attachment B.

Laboratory results will be compiled and evaluated by the Field Station as they are received and the said evaluations forwarded to the Denver Project Headquarters bi-monthly, that is every two months. It is expected that the evaluation will comprise the following:

(a) Inspection of the data for completeness and accuracy and systematic and uniform compilation of laboratory results.

(b) Calculation of the salt burden or tonnages conveyed by the stream during the period of record. Calculation of such secondary properties as the sodium adsorption ratio, percent sodium, and relationships of specific conductivity to total dissolved solids and constituent ions, and relative ionic percentages.

(c) Examination of the proportions of the various ionic constituents with statements as to their significance. [1]

(d) Comparison of the data with previous information acquired by the Field Station; with data furnished from other sources; and with recognized water quality objectives for municipal, industrial, and agricultural use. Graphical expressions will be employed freely in such uses as water quality profiles, percentage composition diagrams, and dissolved solids rating curves at appropriate stations.

Arrangements with the Geological Survey for establishment of new stream gaging stations will be made as required. Sampling locations for which additional gaging may be necessary are included in attachment A, section B.

Field conductivity results to date at main stem stations currently being sampled show that average fluctuations have been 10 percent or less, on a week to week basis at all stations. Data obtained in the previous sampling program conducted from June 1961 through June 1962 for the Colorado River above the mouth of the Gila River, have been examined. The pattern of week to week fluctuations in concentration of total dissolved solids did not differ noticeably whether comparing weekly grab sample data or weekly composite sample data. Therefore, it is believed that weekly grab sampling at river stations will provide sufficiently accurate data. This program will be carried out for a period of three or four months, that is until about February 15, 1964. At that time it is expected that a shipment of recording conductivity meters will be available to supplement the manual sample collection efforts of the Field Station staff. Consequently, after February 15, recording conductivity meters will be installed tentatively at the following stations:

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[1] When water is applied to land in irrigating, a large part of it is transpired by the plants and evaporated from moist soil. Very little of the dissolved salts in the applied water is taken up by the plants; consequently, there is a much greater concentration of salts in the soil solution than in the applied water. Since the carbonates of calcium and magnesium are sparingly soluble, they are precipitated first. The irrigation percolate which finds its way back into the streams through drains or by natural seepage thus contains a higher proportion of sulfates, chlorides, and sodium than the irrigation supply. This increase in the proportion of sodium, chloride, and sulfates, relative to calcium, magnesium and bicarbonates is characteristic of stream water polluted by irrigation drainage. Land drainage so altered has been called irrigation sewage.

Colorado River Indian Reservation Main Canal near Parker, Arizona
Bill Williams River near Alamo Crossing, Arizona
Colorado River near Blythe, California
Colorado River below Cibola Valley, Arizona
Colorado River below Imperial Dam
Colorado River above the Gila River
Gila River near the mouth

Following the installation of these seven conductivity meters, weekly and bi-weekly sample collection may no longer be necessary and may be discontinued. The conductivity meters will provide a record essentially continuous for a period of 28 days. Every four weeks the recording tapes will be removed and replaced, and at the time of servicing the instruments a water sample will be taken for chemical analysis as described in attachment B. This program will continue for the remainder of the Water Year 1964, that is through September 30, 1964.

(4) Saline Waste Water Surveys

The purpose of this activity is to identify sources of salinity pollution, ascertain their size and nature, and show their relative importance.

(a) Natural Sources. Inquiries and reconnaissance of all significant springs tributary to the lower Colorado River will be made. A water quality sampling and flow measurement program commensurate with the importance of the source of water will be carried out. The most significant natural sources located to date are: Blue Spring on the lower Little Colorado in Arizona; Havasu Springs in the Grand Canyon area of Arizona; Littlefield Springs on the Virgin River in Arizona; springs on the lower Muddy River in Nevada; LaVerkin Springs at Hurricane, Utah on the Virgin River; and springs in the lower portion of Kanab Creek in Utah.

The first five spring areas indicated above are areas that are accessible for sampling at any time of the year. It is recommended that sampling be conducted at these five springs on a quarterly basis and would require about 1 1/2 man-months for sampling, gaging, and conductivity measuring for two men. The Kanab Creek area will require sampling for surface and ground water sources but is inaccessible except by pack trip. The lower Kanab Creek area is only accessible during the months of February and March, due to weather conditions that prevail in the area. The sampling trip of this area will require about five days for at least two men. All of the abovementioned areas should be sampled for chemical analysis, gaged for flow, and conductivity measurements to be taken at the field site. Diffuse ground water salt loadings from effluent seepage will be estimated from considerations of salt balance, utilizing conventional hydrologic and geochemical techniques. Location and evaluation of spring and diffuse ground water sources will be the primary responsibility of the Project geologist and Field Station hydrologist.

(b) Municipal and Industrial Sources. Salt Loadings from these sources will be determined by flow measurements, chemical quality sampling, and conductance tests. There are four significant urban areas in the lower main-stem sub-basin: St. George, Utah; Las Vegas, Nevada; Needles, California; and Yuma, Arizona. Field surveys of waste water discharges from municipalities and industries in these four areas will be carried out during two periods, March-April and July-August 1964. At St. George, Utah and Needles, California, the plan is for 24 hours of continuous sample collection and flow measurements, taking samples each of the 24 hours and compositing them for complete chemical and physical analysis, (see attachment B), as well as determination of the 5-day biochemical oxygen demand. Simultaneous observations will be made of waste water discharges, either from the records of the sewage facility, or from gagings made by the Project staff as required.

In the Las Vegas and Yuma areas, sample collection and flow observations will be carried out over a continuous period of 48 hours, with samples composited at the end of each 24-hour period for chemical and physical analysis, as well as determination of the 5-day biochemical oxygen demand. Because of supposed pollution of Las Vegas Wash from organic chemical wastes, samples will also be examined by gas chromatographic techniques for presence of organic groups which may be indicative of artificial pollution. These groups will include if feasible the chloroform extractables sub-classified into aliphatic, aromatic, and oxygenated compounds, acids and bases. In the Las Vegas area additional samples and gagings will be carried out of the effluents of the Southern Nevada Power and Light Plant, the chemical and metallurigical industries of the Basic Management Inc. group near Henderson, and the municipal sewage of Las Vegas. A sample will be collected each shift, that is every eight hours for a 48-hour period, and composited at the end of that time. Records of flow will be obtained, or measurements of flow made at the same time. A similar program will be followed in the Yuma area, and supplementary samples of industrial waste will be collected from the effluent of the Yuma Power & Light Plant at 8 hour intervals for 48 hours.

At the time of the first visit to the communities and industries named the following ancillary data will be obtained: municipalities - population, water supply sources, water treatment methods, chemical quality of water supply*, rate of water use*, sewage flow and method of treatment, type and location of final disposal of sewage; industries-information on location, type of product, plant output and quality and quantity of water supply. Water supply will be classified according to type and use as cooling water, boiler feed water, recycled water, process water and sanitary or miscellaneous purposes.* Information should also be obtained on volume of waste flow, methods of treatment and point of disposal.

(c) Agricultural Return Flows. Salt loadings from this source will be determined by means of appropriate chemical quality sampling, flow measurements, and conductance determinations at all important diversions and surface drains. The major returns are listed below:

Colorado River Indian Reservation Irrigation Project

(1) lateral A19-R37 spill;

(2) upper main drain;

(3) main canal spill;

(4) lower main drain; and

(5) "Bureau of Reclamation" drain;

Palo Verde Irrigation District Outfall drain.

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* Denotes information essential for assessment of salinity damages.

Water quality sampling will be done at weekly or bi-weekly intervals. At least one Water Year of records will be obtained for all points.

Review of data furnished by the Geological Survey for a number of drains in the lower Colondo River area indicate that the quality fluctuations would be minor on a weekly basis. Chemical sampling will be augmented by periodic use of continuous conductivity recorders to provide an indication of quality fluctuations between sampling cycles and to check the validity of sampling intervals. Conductivity versus total dissolved solids relationships will be developed for individual stations as quickly as data permits.

In conjunction with the field surveys of irrigation water salt loadings, the following ancillary data should be obtained from other agencies which are concerned. Most data will be obtained on a monthly basis where available, or on an annual basis.

Type of crops, with acreage and value of each*,

Total diversions of irrigation water, and sources of supply, whether surface or ground water,

Irrigation season and methods employed,

Precipitation records*, (collected by Project Headquarters)

Estimated rates of evaporation from land surfaces*,

Annual consumptive use of water for each principal crop*,

Fertilizer use and costs*,

General description of soil types, (obtained primarily by Project geologist),

Prevalence of, and need for drainage of irrigated land, cost of construction of existing drainage systems*.

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* Denotes information essential for assessment of salinity damages.

Representative data will be obtained for each major irrigation district as a whole or, if not available in this manner, by canvassing a small number of farms in each area and extrapolating the results to the entire irrigation district.

Significant irrigated areas, and their approximate irrigated acreages, within the lower main-stem sub-basin are:

Colorado River Indian Reservation Irrigation Project	34,000	acres
Palo Verde Irrigation District	104,000	"
North Gila Valley Unit, Gila Project	6,200	"
Reservation Division, Yuma Project	11,000	"
Valley Division, Yuma Project 1/	45,000	"
Irrigated lands within the Virgin & Muddy Rivers drainage	13,000	"

(5) Salinity Concentration Influences

(a) Surface evaporation and losses. Information will be secured on the rates of evaporation and canal seepage losses from water surfaces throughout the sub-basin and estimates of the present annual losses by atmospheric evaporation from reservoirs, streams, irrigation canals, and irrigated lands.

(b) Consumptive use of water. Consumptive use by communities and industries will be determined utilizing the data acquired during field surveys if necessary; data previously acquired on consumptive use in agriculture will be supplemented. Consumptive use values may also be estimated from studies made in particular areas by others or calculated by using such techniques as the Blaney-Criddle method.

1/ Return flows from this irrigated area enter the limitrophe section of the Colorado River or are pumped across the International Boundary and do not affect water use within the United States.

(c) Imports and exports of Colorado River Basin water. The volume and chemical quality of water imported to or exported from the basin will be determined. The total amount of dissolved solids annually imported or exported will be calculated. Geological Survey records show three transbasin diversions. The table contained in attachment C indicates the quantities of water exported from the lower main-stem sub-basin for the last five water years of published record. Quality information for the Colorado River aqueduct and the All-American canal is available, and when received, will be utilized in calculating the amount of solids removed from the sub-basin. The small diversion near Pinto, Utah, will be sampled intermittently to provide necessary chemical data. Diversions and diminution of flow due to Mexican water use within the Basin along the International Boundary have not been considered.

(d) Phreatophyte Losses. Estimates will be obtained of present annual consumptive use of water by non-benefit vegetation and the distribution of such water losses according to stream reaches. Studies made by other Federal agencies are expected to provide the greater part of the information required.

(e) Hydrochemical Effects - The following factors affecting water quality will be investigated: natural precipitation of dissolved salts in streams and reservoirs; solution of minerals from channel sediments; and changes in mineral composition resulting from natural ion exchange phenomena. Data on certain of these phenomena will be obtained during a planned cooperative field study with the Geological Survey as described in attachment D.

(6) Preparation of Report

This activity comprises writing the drafts of the report and preparing the necessary graphs, illustrations and tables. The report outline is contained in attachment E.

The report will describe and account for the origin, distribution, concentration and loading of dissolved solids in streams of the sub-basin. All major sources and influences contributing to salinity will be identified. The relative significance of particular sources will be determined, as well as the general consideration of water quality degradation due to salinity.

SALINITY PROGRAM WORK SCHEDULE

It is estimated that 116 man-months of effort (including secretarial time) will be required for completion of engineering studies of saline pollution in the lower main stem sub-basin of the Colorado River. A breakdown of this time is shown below:

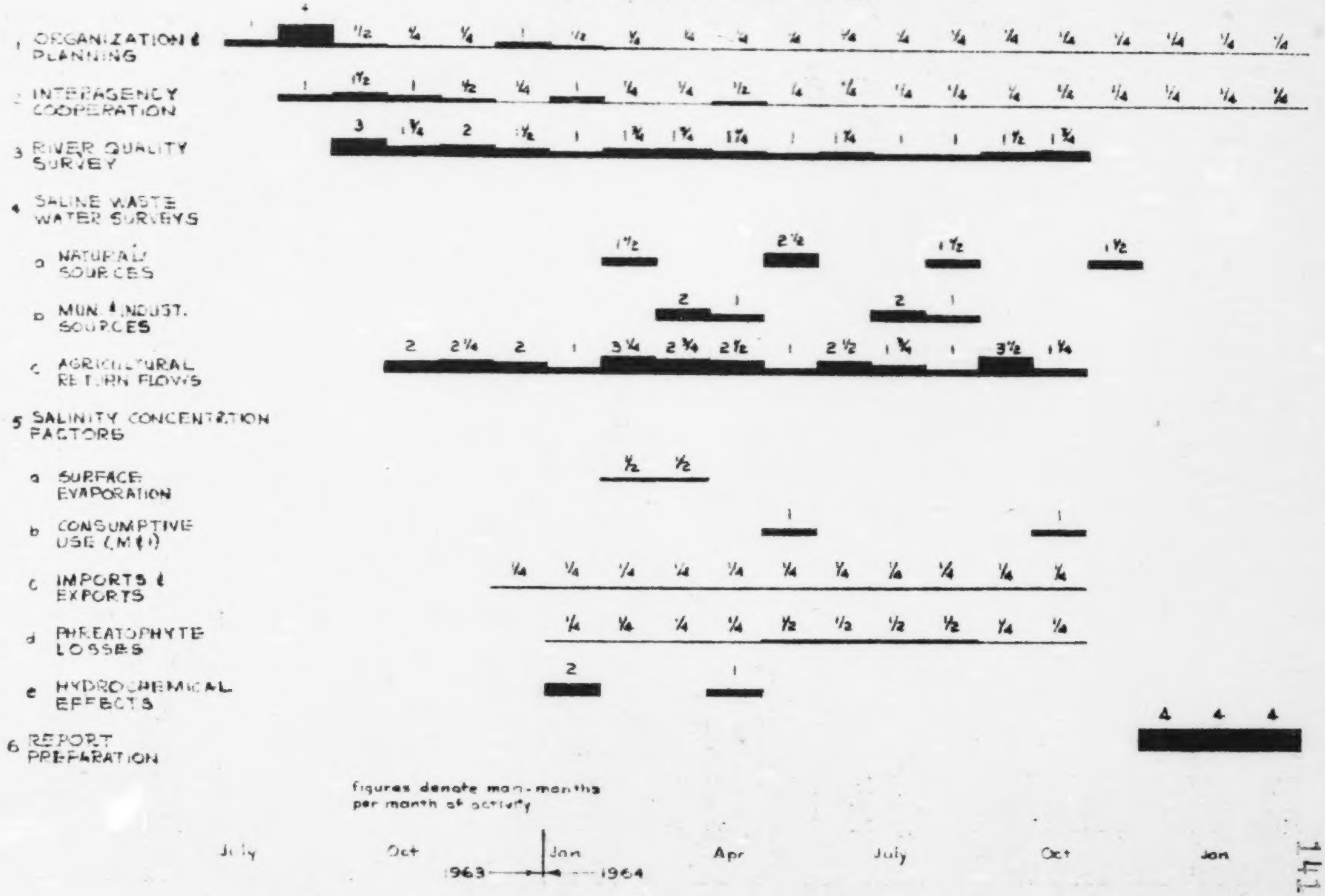
Number	Position	Man-Months of Time
1	Sanitary Engineer (Acting Chief)	14
1	Hydrologist, GS-9 (EOD February 1964)	9
3	Asst. Sanitary Engineers	40
2	Engineering Technicians (GS-5)	32
1	Laboratory Mechanic, GS-7 (EOD January 1964)	10
1	Clerk-Stenographer, GS-4	11
	Total	116

Scheduling for the pesticide data collection program of the Field Station has not been shown separately. The major portions of this activity will be handled concurrently through the river quality (item 3) and the agricultural return flow surveys (item 4c). Therefore, Field Station resources necessary for accomplishment of the pesticide program have been absorbed into the schedule. It is estimated that 6 man-months of time will be required for execution of the pesticide data collection program.

The salinity study within the lower main stem sub-basin and the necessary report will require 20 months for completion from its beginning, July 1, 1963. The control schedule and distribution of working time of the technical staff in the several types of activity are shown graphically in the following figure.

Beginning in April 1964, a portion of the Field Station's effort will be devoted to initiating similar programs of salinity studies in the Gila and Little Colorado River sub-basins. During the period April 1964 through February 1965, a total of 31 man-months of time for professional and technical staff will be applied to salinity studies in these basins. From March through June 1965, all personnel time totaling 32 man-months will be devoted to this work; thus 63 man-months will be utilized in work in the Gila and Little Colorado River sub-basins in Fiscal Year 1965. The plan and schedule of operations for this future work is given in the following chart.

PHOENIX FIELD STATION
SALINITY PROGRAM WORK SCHEDULE
LOWER MAIN STEM SUB-BASIN



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ATTACHMENT A

A. List of river stations currently sampled from Hoover Dam to the Mexican border.

1. Colorado River below Hoover Dam

Flow data can be obtained from the USGS and water quality data is available from the Geological Survey and the Metropolitan Water District of Southern California. Records of stream flow are rated excellent by the USGS. Complete mineral analyses are available for 10-day composite samples. This location is a key reference point on the river system.

2. Colorado River below Davis Dam

Daily stream discharges are available from the USGS; accuracy of records is rated excellent by that agency. This station gives the quality of water below Lake Mohave and is expected to indicate the difference, if any, in quality between this point and that below Parker Dam. (Currently sampled bi-weekly by Project.)

3. Colorado River near Topock

Daily discharge records have been maintained by USGS since 1917, and accuracy of measurement is rated excellent. This station will serve as the upstream reference for water flowing into Lake Havasu. (Currently sampled bi-weekly by Project.)

4. Colorado River Aqueduct 1.8 miles above Parker Dam

The Metropolitan Water District of Southern California maintains a continuous record of flow measured by Venturi meters at the intake works, and also collects daily water samples which are composited at 10-day intervals for complete chemical analysis. Water quality records are continuous, excepting short intervals, since 1941. This location is important since it gives the quality of water above the inflow of irrigation return flows from the Colorado River Indian Reservation and the Palo Verde Irrigation District.

5. Bill Williams River at Alamo Crossing, Arizona

Flow data are available for this station from the USGS; records have been kept since 1939. Accuracy of measurement rated poor to good. Sampling at this location can provide data on the salinity contribution from the Bill Williams River to the Colorado River. (Currently sampled bi-weekly by Project.)

6. Colorado River Indian Reservation Main Canal below Head Gate Rock Dam near Parker, Arizona

Flow data are available from the USGS from 1915 to present. Accuracy rated excellent. This station indicates quality of water in main stem below Parker Dam as well as in the Canal. (Currently sampled weekly by Project.)

7. Palo Verde Canal below diversion dam near Blythe, California

Flow data are available from the USGS and are rated as excellent by them. Sampling at this point can provide water quality data on flow to the Palo Verde Irrigation District, and further, on quality of river water below the Colorado River Indian Reservation's Upper Main Drain which enters the river above this point. (Currently sampled weekly by Project.)

8. Colorado River at Blythe Bridge near Blythe, California

Flow at this point will be calculated from data provided by the USGS for an upriver gaging station. The flow records at this upstream station are considered excellent by the USGS. The purpose of this station is to isolate or separate the effects on water quality in the river due to irrigation returns from the Colorado River Indian

Reservation and Palo Verde Irrigation Districts. All of the irrigation return flow from the Colorado River Indian Reservation has entered the river above this point and essentially none has from the Palo Verde Irrigation District. (Currently sampled weekly by Project.)

9. Colorado River below Cibola Valley

Flow data are available from the USGS. Flow records are considered excellent by the USGS. This station will serve as the downstream reference point in assessing the effect of the Palo Verde Irrigation District. (Currently sampled bi-weekly by Project.)

10. Colorado River below Imperial Dam

Flow data can be obtained from the USGS offices in this area. The records are considered excellent by the USGS. Serves as a check on quality data for the Yuma Main Canal which is routinely collected by the USGS. Also, this station provides water quality information on the water diverted in the Gila Gravity Main Canal. (Currently sampled weekly by Project.)

11. Colorado River above the Gila River

Flow data for the Colorado River below Imperial Dam will also be appropriate for this sampling point. Quality data are available from the International Boundary and Water Commission. Station will serve as reference for water entering Yuma area. The IBWC is currently sampling at this location on a daily basis and is obtaining complete chemical data on a resulting weekly composite.

12. Gila River near mouth

Flow data are available from the USBR. The flow at the mouth is calculated from the summation of measured inflows. Quality samples are being taken by the International Boundary and Water Commission and data are available from them. The Gila River at this point is primarily return flow from the Wellton-Mohawk Irrigation District. The IBWC is currently sampling at this location on a daily basis and is obtaining complete chemical data on a resulting weekly composite.

13. Colorado River at Yuma, Arizona.

Flow records are obtainable from the USGS and are considered excellent by them. Monthly quality data are also available from the USGS. However, this data will be supplemented by Project sampling. This station serves to provide information on the effects of the Gila River inflow on the main stem.

14. Yuma Main Canal below Colorado River Siphon

Excellent flow and quality data can be obtained from the USGS. If data at this station are corroborated by the station noted under number 10, that station will be discontinued and the data for this station utilized.

15. Colorado River at Northerly U.S.-Mexico Border

Excellent water quality and flow data may be obtained from the International Boundary and Water Commission for this station. The IBWC is currently sampling at this location on a daily basis and is obtaining complete chemical data on a resulting weekly composite.

B. List of proposed river stations between Lees Ferry and Hoover Dam.

1. Colorado River at Lees Ferry

Both flow and water quality data are obtained by the USGS on a routine basis. The flow records are considered excellent by the USGS. This location is a reference point on the Colorado River.

2. Paria River near Lees Ferry

Flow data only are available for this location. These flow records are considered good by the USGS. Contribution of salinity from the Paria River must be added to that at Lees Ferry on the Colorado River to determine the total amount of solids entering the Lower Basin. (Bi-weekly sampling by Project will begin in January 1964.)

3. Little Colorado River near Cameron, Arizona

Flow data may be obtained from the USGS and are considered good by that agency. This station, located near the mouth of the Little Colorado River, gives contribution of salinity to the Colorado River from this drainage area. (Bi-weekly sampling by Project will begin in January 1964).

4. Colorado River near Grand Canyon

Both flow and water quality data are routinely collected by the USGS at this location. Flow records are considered excellent by that agency. This station is a reference point and further, gives the water quality conditions before the Colorado River is impounded by Hoover Dam.

5. North Fork Virgin River near Springdale, Utah

Flow data are available for this point. The stream flow data are considered good by the USGS. The North Fork Virgin River is an important flow contributor to the Virgin River. (Bi-weekly sampling by Project will begin January 1964.)

6. Virgin River below confluence of North Fork Virgin River near Springdale, Utah

Neither flow nor water quality data is available for this location. This point will serve to provide background water quality data on the Virgin River above extensive irrigation development and other sources. Arrangements will have to be made with USGS for establishment of gaging facilities. In the interim it will be necessary for the Project to make its own flow measurements. (Bi-weekly sampling by Project will begin January 1964.)

7. Virgin River at Virgin, Utah

Flow data are available from the USGS. These flow records are considered good by the USGS. This point can provide data on water quality conditions of the Virgin River above the entry of the Santa Clara River. (Bi-weekly sampling by Project will begin January 1964.)

8. Virgin River at Littlefield, Arizona

Water quality and flow data may be obtained from the USGS. Flow records are considered good by the USGS. This location is important since it provides data on the contribution of salinity entering Lake Mead by the Virgin River. Additional gaging and sampling by the Project, beginning in January 1964, may be necessary near the mouth of the Virgin River to verify the data at the Littlefield USGS station.

9. Muddy River near Glendale, Nevada

Flow data are available for this location. Flow records are considered good by the USGS. Sampling data can provide information on the salinity contribution from the Muddy River into the Overton Arm of Lake Mead. Below the USGS gage and above the mouth, a large portion of the flow of the Muddy River is diverted. Therefore, it may be necessary for the Project to do some supplementary gaging and sampling near the mouth to account for any differences this diversion may cause. (Bi-weekly sampling by Project will begin January 1964.)

10. Las Vegas Wash near Henderson, Nevada

Flow data are available from USGS. The flow records are considered good by that agency. This station is necessary to indicate the contribution of municipal and industrial effluent from Las Vegas and Henderson, Nevada to Lake Mead. The USGS gage may not be sufficiently near the mouth to include the entire flow into Lake Mead and, therefore, it may be necessary for arrangements to be made for gaging nearer the mouth. Supplementary gaging may be required of the Project to verify this situation. (Bi-weekly sampling by Project will begin January 1964.)

C. List of stations to be sampled periodically (due to difficulty in reaching these locations.)

1. Bright Angel Creek near Grand Canyon, Arizona

Flow data are available for this location from the USGS. The flow records are considered good by that agency. Bright Angel Creek contributes a fair amount of flow to the Colorado River and furthermore, may receive the inflow from natural saline springs in this area.

1/7/64

ATTACHMENT B

CHEMICAL CONSTITUENTS AND PARAMETERS TO BE CONSIDERED IN THE LOWER MAIN-STEM SALINITY PROGRAM

1. For purposes of general clarification, the term "salinity" is considered to be synonymous with "total dissolved solids" and refers to the summation of individual constituents present in a given water sample.

2. The following is a minimum listing of constituents that should be routinely evaluated in all sampling activities for the reasons indicated and for checking and/or computing total dissolved solids values:

Calcium--present in nearly all waters and is the major component of hardness.

Magnesium--may contribute to laxative effects if present in high concentrations.

Sodium and Potassium--High percentages of sodium in irrigation waters are injurious to certain crops.

Chloride--One source of taste in domestic water and may be harmful to the irrigated crops at higher concentrations.

Sulfate--Most abundant anion in many waters and may have laxative effects when present in higher concentrations.

Bicarbonate and carbonate--Important constituent in most natural waters; however, carbonate is not normally present in significant amounts except in waters of high pH.

Boron--Important constituent in determing suitability of water for irrigation.

Silica--A factor in turbidity considerations of water.

Total dissolved solids--Important consideration in evaluating suitability of water for domestic and agricultural use.

3. In addition, the following constituents should be evaluated on a bi-monthly basis to more fully characterize quality conditions:

Iron and manganese--High concentrations have adverse effect on suitability of water for domestic use.

Phosphate and nitrate--Nutrients which may promote growth of aquatic life and also nuisance algae. Nitrates are harmful to children if present in significant concentrations.

4. The following constituents can present toxicity problems in certain areas when present in significant quantities. Certain of these elements will be evaluated from time to time when local conditions dictate:

Human		Aquatic life, stock watering and irrigation	
Arsenic	Cyanide	Aluminum	Cyanide
Barium	Fluorine	Arsenic	Lead
Cadmium	Lead	Cadmium	Mercury
Chromium	Selenium	Copper	Selenium
Silver		Chromium	Zinc

5. The following physical and/or chemical parameters will be routinely evaluated to more fully characterize water quality:

Specific conductance--Can be mathematically related to concentration of various ions or total solids in a given location.

Percent sodium and sodium adsorption ratio--important in evaluating suitability of water for irrigation use.

Alkalinity--measure of buffering capacity of water.

Hardness--Affects domestic, industrial, and agricultural use.

pH and temperature--Useful in evaluating water quality.

ATTACHMENT C

TRANS-BASIN DIVERSIONS

LOWER MAIN STEM SUB-BASIN

STATION (USGS)	YEARLY FLOW IN ACRE-FEET FOR WATER-YEAR				
	1958	1959	1960	1961	1962
Santa Clara-Pinto diversion near Pinto, Utah	4,150	39.5	1,130	2,820	3,330
Colorado River aqueduct near Parker Dam, Arizona-Calif.	542,193	660,721	851,203	1,064,5[illegible]2	1,039,377
All-American Canal to Southern California 1/	3,299,000	3,503,000	3,581,500	3,635,600	3,612,700

1/ This value is the difference between flow in the All-American Canal above Pilot Knob wasteway and Pilot Knob wasteway near Pilot Knob.

ATTACHMENT D 1/3/64

LOWER COLORADO RIVER COOPERATIVE WATER QUALITY STUDY
PUBLIC HEALTH SERVICE AND GEOLOGICAL SURVEY

During a visit to Yuma by Project staff members in August 1963, field representatives of the Ground Water Branch, U. S. Geological Survey, suggested a cooperative study, short but intensive, of certain water quality conditions in the 350 mile reach of the Colorado River between Hoover Dam and the northerly boundary with Mexico. Assistance of the Public Health Service was invited because locally available personnel of the Geological Survey were not sufficient to carry out the job unaided. Since the proposed study appeared to be mutually advantageous, their suggestion was adopted and plans are going forward for the cooperative study late in January or in February 1964. Field work is expected to require about 10 days. A part of the laboratory personnel of the Colorado River Basin Project Laboratory in Salt Lake City will take part in this study, as well as the entire staff of the Phoenix Field Station.

The primary objective of this work is to determine the nature and distribution of water quality changes downstream from Hoover Dam due to chemical precipitation, ion exchange, and the solution of mineral ions from sediments of the river beds and banks. These factors are unknown or but imperfectly known at present. If the study achieves its objective it will show the net direction and magnitude of these phenomena, and will enable their effects to be compared with the changes in water quality induced by human activities.

1/8/64

ATTACHMENT E

PROPOSED OUTLINE FOR REPORT ON THE LOWER COLORADO RIVER BASIN SALINITY INVESTIGATIONS

TITLE

TABLE OF CONTENTS

ACKNOWLEDGMENTS

SUMMARY AND CONCLUSIONS

INTRODUCTION

AUTHORIZATION
OBJECTIVES OF STUDY
SCOPE OF STUDY AND REPORT

This section will describe the type of data sought; survey and laboratory methods employed; distribution and location of water quality sampling stations; and relation to work of other organizations. It will also have a summary of the contents of the report.

PREVIOUS INVESTIGATIONS AND REPORTS

Append a bibliography if necessary.

AREA OF INVESTIGATION

Describe boundaries, area encompassed, orientation of the area with respect to adjacent regions, and include a location map.

PHYSICAL GEOGRAPHY

The geomorphology, structural geology, physical relief and elevations of the area of study.

CLIMATE

Describe the types and character of climates, temperature ranges, and the occurrence, amount, and sources of precipitation.

DESCRIPTIVE HYDROLOGY

This section should describe the stream systems, watershed areas, run-off characteristics, location and length of record of the principal stream gaging stations, and the mean annual stream flows. It may also give the location and type of the principal ground water bearing deposits, their characteristics and relative importance.

ECONOMIC DEVELOPMENT AND LAND USE

Give statistics on the population and its distribution, major urban centers, and population growth trends. Manufacturing and commerce. Agricultural activity, including livestock raising. Irrigation and other beneficial water uses. Tourism. Federal Government activities and Government-controlled land, including military and Indian reservations, National parks and forests. Cite factors limiting economic growth.

CRITERIA OF WATER QUALITY

MUNICIPAL AND DOMESTIC SUPPLY
IRRIGATION
INDUSTRIAL
FISH AND OTHER AQUATIC LIFE
RECREATION

STREAMFLOWS

SOURCES OF DATA
TABULATION AND PREPARATION OF HYDROGRAPHS OF FLOW FOR THE PERIOD OF THE WATER QUALITY STUDY

QUALITY OF WATER

COLORADO RIVER MAIN-STEM

LEE FERRY TO LAKE MEAD

This section should present information on quality of influent river water at Lee Ferry, salt contributions from tributaries of the main stream, salt contributions from influent groundwaters, irrigation return flows, salts from sewage and industrial wastes, including mining wastes, salt concentration by evapo-transpiration, salt dilution due to rainfall, and salt losses due to natural ion exchange and chemical precipitation.

LAKE MEAD TO INTERNATIONAL BOUNDARY

Repeat the presentation and discussion of data as done in the preceding section.

EVALUATION OF FINDINGS

SUITABILITY OF WATER FOR BENEFICIAL USES

In this section evaluate water quality in the major tributaries and in successive reaches of the main stem, for all important beneficial uses, including the following:

- Domestic supply
- Agricultural
- Industrial
- Propagation of fish and aquatic life
- Recreation
- All other uses

ABATEMENT OF SALINITY

For each major tributary and for the main stem, discuss preventable salt loadings, their causes, possible methods for reduction, and the technical feasibility, cost, and benefits. Include a suggested program for action. Measures to be considered should of course include not only exclusion, removal, or demineralization of mineralized waste waters, but also such indirect controls as reducing water losses through evaporation, canal seepage and consumption by non-beneficial vegetation or phreatophytes.

APPENDIX C

Economic Study of the Colorado River Basin
October 1, 1963 - December 20, 1963

Completion of Surveys

All interview schedules for the three lower Colorado River sub-basins had been received by the end of this period. It is regrettable that interviewing had to be terminated ahead of schedule. But a preliminary audit of the results indicates that the data should be adequate for all sectors of the projected input-output tables, for which Colorado University and the University of New Mexico have responsibility. As always, the data are better and more complete for some sectors than for others.

A record of each questionnaire received has been entered in a log book. Each questionnaire has been audited for internal consistency, and we have started to transfer data from the interview schedules to IBM recapitulation sheets designed for this survey with the aid of Parker Fowler of the University of New Mexico Data Processing Center.

As soon as a sufficient number of recapitulation sheets have been completed we will start punching the IBM cards. Initially, this work will be done on the keypunching machine in the Institute of Behavioral Science at the University of Colorado. If card punching proceeds rapidly enough on this machine to meet our timetable the work will be completed without renting additional equipment. If necessary, however, we will lease a second IBM keypunching machine and employ additional keypunchers to meet our schedules. This can be done within the limits of our present budget.

Our current plan is to store all data on magnetic tape after the analysis has been completed. IBM cards will then be transferred to the University of New Mexico for storage and for later use if necessary.

Revision of the Green Sub-Basin Input-Output Table

During this reporting period programs for the construction of a table of direct coefficients, and for the inversion of the Leontief matrix (I - A) were completed and tested. A new corrected transactions table was completed for the Green Sub-Basin. This required major adjustments in one sector -- the Gross Private Capital Formation sector -- and minor adjustments throughout the table. This table has been completed, checked, and is being typed. A new table of direct coefficients has also been completed, and this has been inverted. Copies of all tables will be sent to the University of New Mexico as soon as they can be typed.

All final demand projections for the Green Sub-Basin have been revised on the basis of more complete information. Using these final-demand projections, the processing sectors of basic transactions tables have been constructed for 1965, 1980 and 2010. These will be transferred from IBM tapes to typewritten tables as rapidly as possible.

Revision of the Energy Section of the Green Sub-Basin Report

We are now in the process of revising the preliminary report on the energy sectors of the Green Sub-Basin economy. The revision is based on the corrected transactions table and the new inverse matrix. The revised report should be completed shortly after the first of the year.

Projections of Heavy Water Using Industries in the Three Lower Sub-Basins

A considerable amount of time and effort during this reporting period was devoted to projections for 1965, 1980 and 2010, by county, of total gross output for the following heavy water using industries: (1) food and kindred products, (2) paper and pulp, (3) chemicals and allied products, (4) petroleum and coal products, and (5) primary metals. In addition, although this was not requested, projections of copper production for the same years were made.

Subsequently, the food and kindred products projections were revised on the basis of new population projections and anticipated increases in personal income. Also, a detailed breakdown by 4-digit Standard Industrial Classification, by county, was made for the five heavy water-using industries listed above. All projections and breakdowns have been transmitted to the University of New Mexico.

Projected Work for the Next Reporting Period

Our efforts during the coming quarter will be concentrated on the construction of basic transactions tables for 1960 for the three Lower Sub-Basins. The first step will be to complete punching of data on IBM cards. While this is going on, we will continue to work on the development of control totals. Once the control totals are available, we will begin a series of computer runs to obtain the first approximations of inter-industry flows.

We currently plan to make independent estimates of output (row) and input (column) flows. Examination of the estimates will then indicate the extent to which intersections will require reconciliation. We hope that much of the initial work can be done by computer. There is no short-cut method, however, for working out the reconciliations. This will have to be done, as in the Green Sub-Basin, on a sector by sector basis.

In terms of priority, data on the wholesale and retail sectors will be processed first. After our first estimates have been made these can be sent to the University of New Mexico for adjustment and refinement.

We have been notified by Clyde Stewart that he expects to have agricultural data for the lower main-stem by February 1, and hopes to have agricultural data for the Little Colorado and Gila shortly after that date. If this schedule can be met, and if control totals are made available to us by February 1, it is not unreasonable to expect that the basic transactions tables can be completed by the end of March. Subsequent computional work will proceed much more rapidly than in the case of the Green.

Data Problems

Our major concern at the moment is the collection of data to be used for control totals. We were fortunate in the Green to have the complete cooperation of state agencies (including the Bureau of Economic Research at the University of Utah), trade associations and individual businessmen. Also, the Green is highly specialized in petroleum and gas, while the three lower sub-basins are more diversified. We need more control totals for the lower sub-basins, and at the moment we are not certain where all of these will come from. One member of our staff is currently devoting most of his time to a search for data on total sales, total production, etc. If we are to remain on schedule, and start work on the transactions tables early in February, we will need at least one reliable control total for each sector of each of the three sub-basin tables. Ideally, the control total for each sector would be total gross output for calendar 1960.